THE TUBE REBRANDING RACKET

RADIO & TELEVISION NEWS

JULY
1956
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World's Leading Electronics Magazine

IN THIS ISSUE

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NEW TECHNIQUES FOR
REPAIRING PORTABLE SETS

A PORTABLE
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COMMERCIAL ASPECTS OF
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KEEP YOUR SCOPE OPERATING

70-WATT AMPLIFIER SYSTEM

DOING IT THE EASY WAY
(See Page 38)

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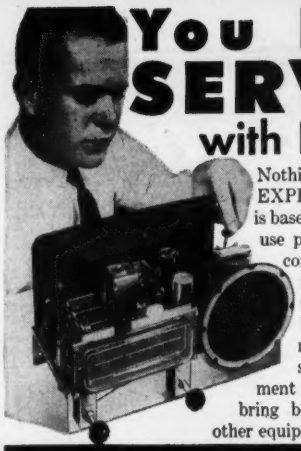

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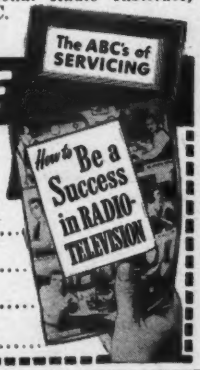

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COVER PHOTO: Part of the "dream" antenna setup of W4YI and W4TFP, Sarasota, Florida. The Steinmetz "team" have their three Telrex beams mounted atop 50-foot mast. For details see article, page 38. (Ektachrome by Joseph Steinmetz)

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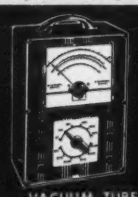

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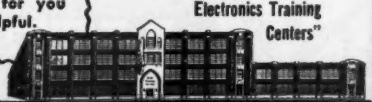

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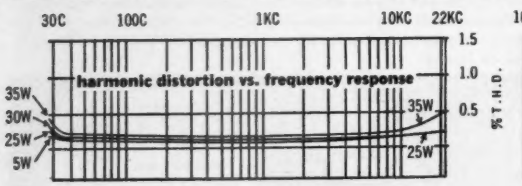
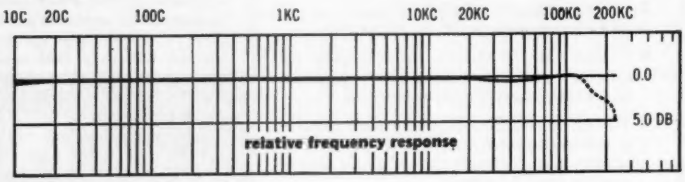
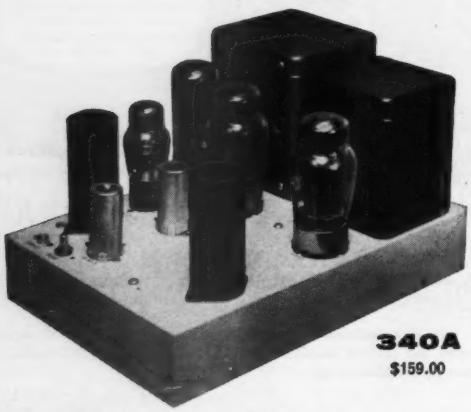
FREQUENCY RESPONSE should be given at a stated power output since an amplifier's response curve can vary drastically with changing output powers.	within 1 db 5 - 100,000 cps	within 1 db 5 - 100,000 cps 0 to 5 watts output within 0.1 db 30 - 22,000 cps 0 to 35 watts output
DISTORTION varies with frequency and power output (see curve) and should be stated at full power over a specific range, otherwise it may refer to the lowest distortion point in the mid-range.	0.2% at 35 watts	less than 0.5% 30-22,000 cps at 35 watts less than 0.2% 30-22,000 cps at 5 watts
INTERMODULATION should be measured at full power using a low (under 45 cps) test frequency. Use of a higher frequency and a selected lesser power output results in an unrealistically low intermodulation figure.	0.5% at 15 watts 60 cps and 7 kc, 4:1 ratio	1.0% at 35 watts 40 cps and 2 kc, 4:1 ratio







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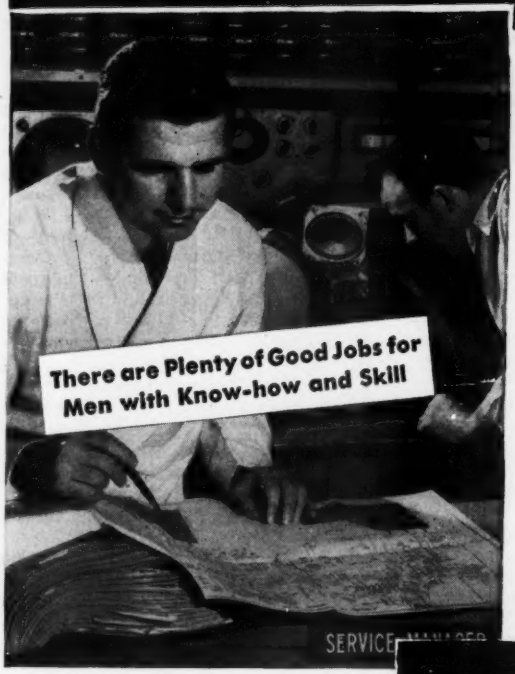

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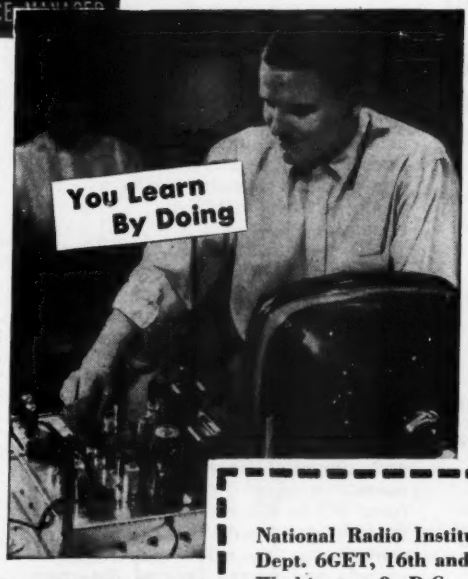

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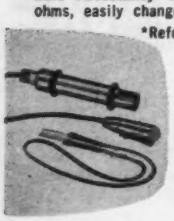

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RADIO SHOWS THEN AND NOW

I AM, at this moment, attending our 34th "Parts Show" in Chicago. Many changes have been noted since 1922 when, in this same metropolis, I entered the Leiter Building to visit "The Chicago Radio Show." My job, at the time, was to "service" *Radiola, Fada, Grebe, Tuska* and *Westinghouse* radio sets at the *Central Electric Company.*

The technique of "service" in those days consisted of either replacing a burned-out vacuum tube or a "B" battery. Commercial radio receivers were still something new. For several years the public had been building its own receivers from data published in RADIO & TELEVISION NEWS (then Radio News) and little "know-how" was required to diagnose the few ills that beset the radio receiver of that era. The only test instrument required was a low resistance voltmeter.

So-called "Radio Shows" were open to the general public for many years and at the one we attended in 1922, more than 20,000 individuals paid admission to witness the latest products of this industry. Primitive machines on display (considered marvelous when wireless first was demonstrated) recalled memories of the immortal *Binnes* and the ill-fated "Republic" match box and finger-ring receivers. There were plenty of radio cabinets of the Chippendale, Sheraton, and Queen Anne designs, also the Aeriola Grands. A limitless number of home-made receivers included the regenerative, Hertz, Neutrodynes, and a few sets recognized commercially as being produced by established manufacturers.

We recall vividly the displays of workmanship from high school students. Several wood-turning exhibits showed how variometer parts could be easily made from data supplied by this publication and from weekly "how to" radio projects in the newspapers. Contests were held for making the best radio novelty, the best loudspeaker, and the best regenerative detector and amplifier receiver designed to operate over a wavelength range of from 175 to 600 meters. Local music dealers participated in these early shows as well as a few manufacturers of sets and parts. Crystal detectors, loose couplers, variometers, and other components were displayed and the public was told how to make them. An open forum introduced the topic of present business and future business, fads, and the question of formation of a *National Radio Jobbers Association.*

Radio "bootleggers" were denounced and claims were made by a Boston concern to the effect that it was the only licensed crystal detector maker in the country.

Several forums were held during the Show to discuss radio prices, deliveries, the maintenance of newspaper interest, dealers' service to customers (a very vital subject indeed, for such service was badly neglected), and an effective method of reaching the farmers. Other meetings were devoted to civic matters, connected with radio, on an industrial level.

Alexander Eisemann, President of the *National Radio Chamber of Commerce,* addressed the convention from New York City. He said that "quantities of radio apparatus are made to sell but not to use. Radio factories are springing up all over the country and thousands of manufacturers, without previous experience, are building what they call radio outfits. These are built in so-called radio laboratories, but just as being born in a stable does not make one a horse, much of this apparatus called radio-receiving outfits fails to receive."

Many of the early pioneers of radio and television are still alive and very active in our industry. Each year I look forward to the annual get together of "Radio's Old Timers" and to recall the early days when our Annual Show was more of a public than an industry affair.

The electronics industry has grown so tremendously in recent years and merchandising methods have changed so radically that our annual Parts Show, due to space limitation, is now confined to the manufacturer, his representatives, and his distributors. Even with this limitation, our annual Show, to which the public is no longer admitted, dwarfs the early displays attended by the public.

Forecasts made in 1922 are indeed interesting to those of us who have grown up with this industry. It was stated at the Chicago Radio Show that "radio is fast becoming a part of American home life, and when a large percentage of American homes are fitted with radio outfits, a great public demand will have been created for broadcasting. This demand will make itself felt in a political manner and it is conceivable that Mayors and Governors may be elected because they gave the public better broadcasting than their predecessors."

To the above quotation we add the magic word "TV." We are about to witness, in 1956, the fruition of TV as the most influential dynamic force in the history of politics. It is made possible by the pioneer experimenters of yesterday. . . . . O. R.

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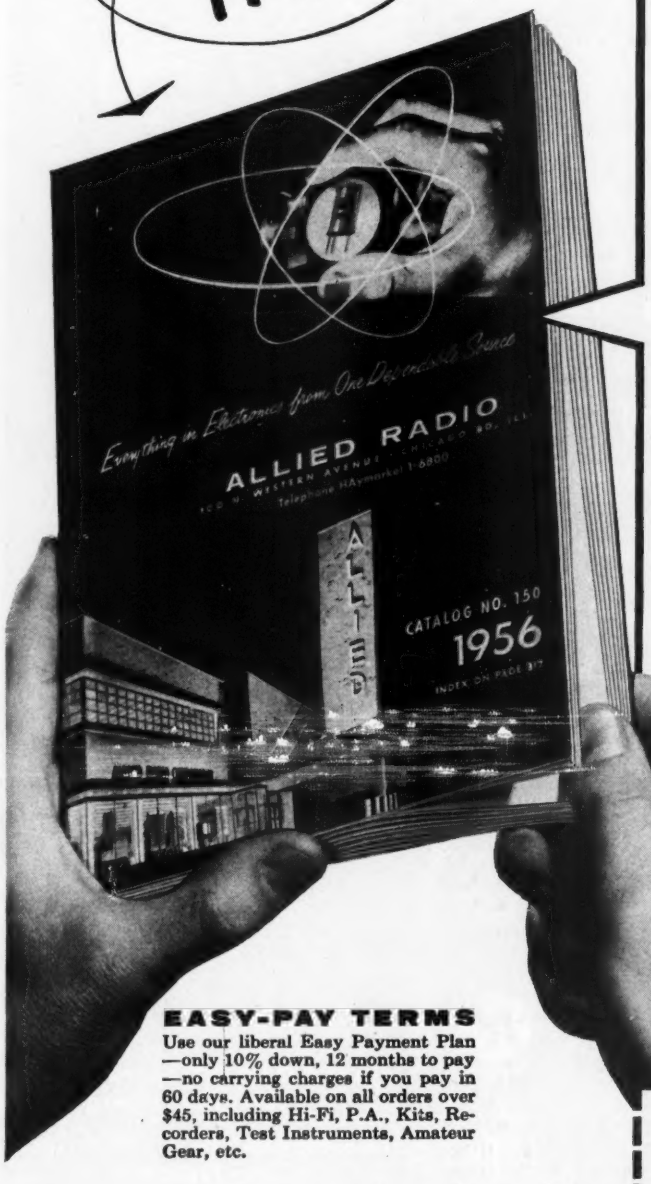

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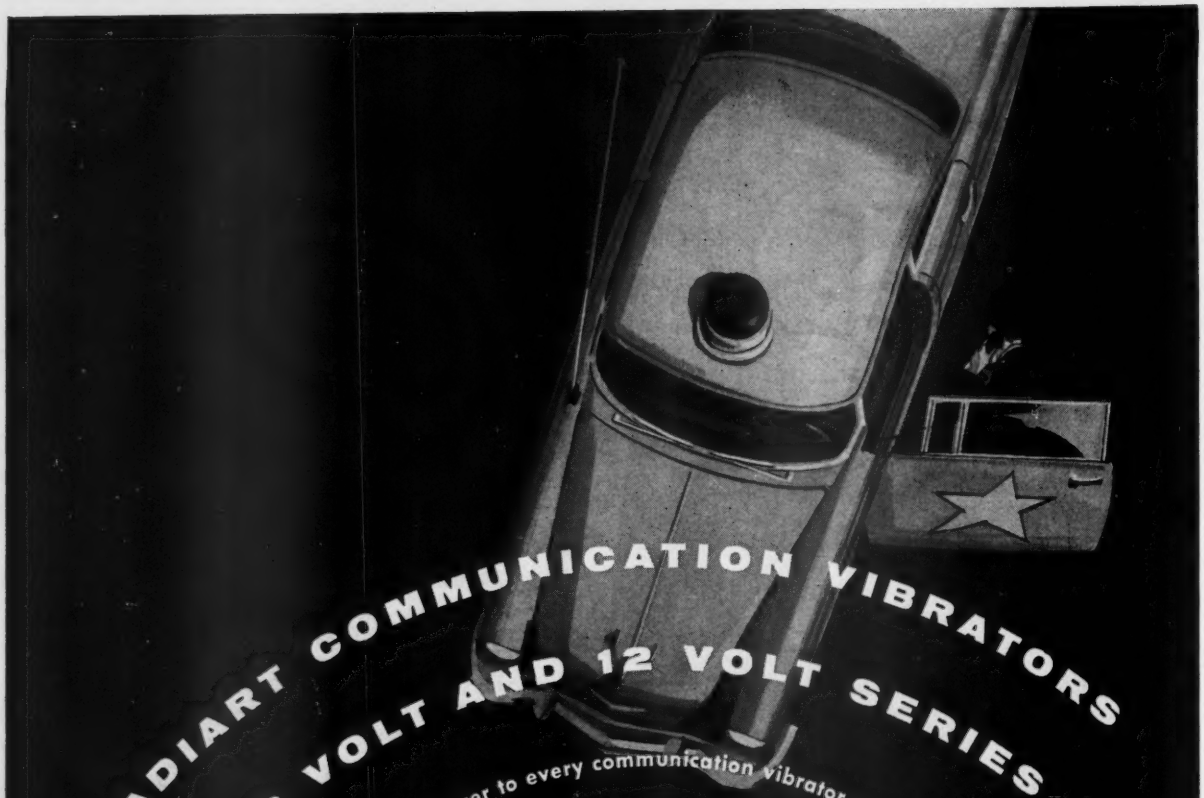

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These 10 Types Offer Proper Replacement For Original Communication Equipment

Here is a 6 volt vibrator for EACH 6 volt operation and a 12 volt vibrator for EACH 12 volt operation!

Old Number	New Number	
	6 volt	12 volt
5515	5715	6715
5518	5718	6718
★	5721	6721
★	5722	6722
★	5725	6725
5605	5805	6805
5620	5820	6820
5621	5821	6821
5622	5822	6822
★	5824	6824

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If you fail to pass your Commercial License exam after completing our course, we guarantee to continue your training without additional cost of any kind until you successfully obtain your Commercial License.

WE GUARANTEE

TO TRAIN AND COACH YOU AT HOME IN SPARE TIME UNTIL YOU GET

YOUR FCC LICENSE

If you have had any practical experience—amateur, Army, Navy, radio repair, or experimenting.

● TELLS HOW-

Employers make JOB OFFERS Like These to Our Graduates Every Month

Transcontinental Airline: "American Airlines is very much interested in receiving applications from CIRE trainees. We have immediate need for technicians in many cities."

West Coast Manufacturer: "We are currently in need of men with electronics training or experience in radar maintenance, and we would appreciate if you will refer interested persons to us."

Letter from nationally-known Manufacturer: "We have a very great need at the present time for radio electronics technicians and would appreciate any helpful suggestions that you may be able to offer."

These are just a few examples of the job offers that come to our office periodically. Some licensed technician filled each of these jobs . . . it might have been you!

HERE'S PROOF FCC LICENSES ARE OFTEN SECURED IN A FEW HOURS OF STUDY With OUR Coaching AT HOME In Spare Time.

Name and Address	License	Lessons
A/1C Ronald H. Person St. Louis 20, Mo.	1st	25 weeks
Milton L. Geisler, ET3 FPO, San Francisco, Calif.	1st	26 weeks
Marvin F. Kimball Lafayette, Ind.	2nd	21 weeks
L. M. Bonino Harlington AFB, Tex.	2nd	16 weeks
John E. Hutchison Bluefield, W. Va.	1st	27 weeks

Carl E. Smith, E. E., Consulting Engineer, President
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Member, National Home Study Council

● TELLS HOW-

EFFECTIVE JOB-FINDING SERVICE HELPS CIRE TRAINEES GET BETTER JOBS

Here Are Just a Few Recent Examples of Job-Finding Results:

ELECTRONICS TECHNICIAN

"I am now employed by the Collins Radio Company as a Lab Technician. (This job was listed in your bulletin.) I have used the information gathered from your course in so many ways and I know that my training with CIRE helped me a great deal to obtain this job."

Charles D. Sindelar, Cedar Rapids, Iowa

AIRLINES

"I replied to the Job Opportunities you sent me and I am now a radio operator with American Airlines. You have my hearty recommendation for your training and your Job-Finding Service."

James A. Wright, Beltsville, Md.

INDUSTRIAL ELECTRONICS

"Upon my discharge from the Navy I used your Job-Finding Service and as a result I was employed by North American Aviation in electronic assembly (final checkout)."

Glen A. Furlong, Fresno, Calif.

OURS IS THE ONLY HOME STUDY COURSE WHICH SUPPLIES FCC-TYPE EXAMINATIONS WITH ALL LESSONS AND FINAL TESTS.

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(Address to Desk No. to Avoid Delay)

Please send at once, without obligation, your FREE booklet, "How to Pass FCC License Examinations" (does not cover exams for Amateur License); a sample FCC-type lesson and the important new information booklet, "Money-making FCC License Information."

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NEW SERVICE-DESIGNED 6AL5

NOW G-E SERVICE-54% OF YOUR

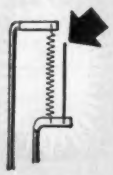
With 20 popular types you cut call-backs,

Ready: 6 brand-new Service-Designed Tubes for increased volume!

NEW 1X2-A/B. *New filament shield post* ("lightning rod") helps to neutralize electrostatic pull of anode, reducing filament pull-outs to a minimum.

- Filament has special new coating that adheres closely, and will not flake off and expose the wire. Cuts tube arc-overs.
- Tubes are life-tested under actual operating conditions, including peak voltages that will be encountered. Assures dependable performance!

PROTECTS AGAINST FILAMENT PULL-OUTS.



NEW 6AL5. *New, advanced heater design* limits initial voltage surges when tube is used in early-model series-string receivers. Same advantage applies in parallel-connected circuits. Tube flash burn-outs are greatly reduced. Vertical bars at right show approximate drop in initial voltage surges between heater of old tube and new Service-Designed 6AL5.

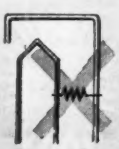
- New heater design also minimizes heater-cathode leakage. This is an important "plus" in AGC and video-detector applications.

HEATER VOLTAGE SURGES REDUCED.

NEW 6BK7-A, 6BQ7-A, 6BZ7. *Improved heater design* provides better heater-cathode insulation. Cuts shorts to a minimum, acts to prevent tube burn-outs.

- Heater-cathode leakage is greatly reduced. Gives improved tube operation, and stabilizes tube performance.
- High zero-bias Gm. This increases tube gain and improves TV reception in fringe areas, giving a clearer, sharper picture.

YOU CAN CROSS OFF HEATER-CATHODE SHORTS!



NEW 6CB6. *New sprayed micas* combat inter-element leakage, improving AGC performance by reducing any tube leakage in the controlled 6CB6 stages.

- Special-alloy screen grid gives superior heat dissipation. Result: freedom from G_1 and G_2 grid distortion and shorts.
- High zero-bias Gm, for improved fringe-area reception. Helps make the new 6CB6 a better-performing, more dependable tube!

REGULAR MICA, DEPOSITS WILL CAUSE LEAKAGE.

NEW, SPRAYED G-E MICA IS LEAKAGE-RESISTANT!

DESIGNED TUBES MEET REPLACEMENT NEEDS !

please customers on more than half your TV tube sales

EVERY new General Electric Service-Designed Tube increases your profit opportunity. The 6 new types now available give you 20 Service-Designed Tubes in all . . . and by actual sales count for the year 1955, these 20 tubes meet 54 percent of your total TV replacement requirements!

Customer goodwill gets a big boost when you can put long life, improved performance into over half the tube sockets you fill! Call-back costs drop sharply. Your tube inventory needs are consolidated — for General Electric Service-Designed Tubes give top performance in *all* chassis!

G.E.'s first group of Service-Designed Tubes met 29 percent of all TV replacement needs. Now your sales potential is nearly doubled. Still more Service-Designed Tubes are in development . . . will increase your share of the tube market further.

Stock and install G-E Service-Designed Tubes! They cost no more than other tubes, are fully interchangeable with prototypes. They're widely advertised, nationally popular. Your G-E tube distributor has them. Phone him today! *Tube Department, General Electric Co., Schenectady 5, N. Y.*

THESE 20 TUBES ARE "MONEY IN YOUR POCKET"!

Clip out this list of General Electric Service-Designed Tubes . . . it will fit neatly in your wallet. A handy guide to types available!

1B3-GT	6AV5-GA	6BQ7-A	6CD6-GA
1X2-A/B	6AX4-GT	6BX7-GT	6J6
5U4-GA/GB	6BG6-GA	6BZ7	6SN7-GTB
5Y3-GT	6BK7-A	6CB6	12SN7-GTA
6AL5			25CD6-GB
6BQ6-GA/6CU6			25BQ6-GA/25CU6

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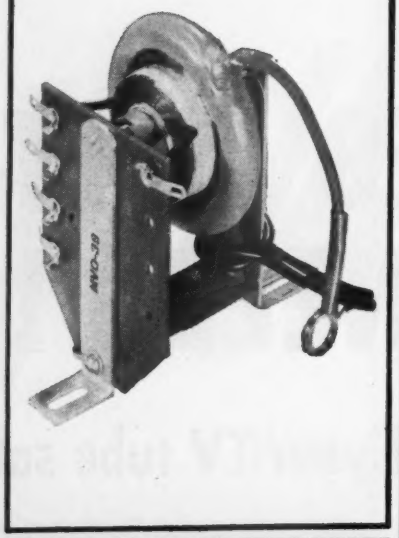

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Spot Radio News

★ **Presenting latest information on the Radio Industry.**

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

A SENSATIONALLY DIFFERENT reallocation plan, that would shatter completely the present system, was under investigation by the Commission as this column was being prepared. The radical proposal calls for the exclusive assignment of the ultra-high channels from Chicago east, with Chicago down to New Orleans suggested as the dividing line, and everything west of this demarcation predominantly in the very-high camp.

The bold move was based on the conclusions that the dozen v.h.f. channels we now have are not adequate for a nationwide competitive system; the ultra-highs must eventually be used and must be given a lift so that they will surely succeed; and three or more competitive outlets must be provided in all or as many of the hundred basic markets as possible.

Aware of the complexity of the change, the plan noted that v.h.f. operators falling in the u.h.f. area would have a transition period of at least ten years (perhaps twelve) to amortize their very-high equipment costs. The proponents of the far-reaching idea also said that sometime during the changeover period, perhaps about the middle, v.h.f. operators would be required to begin dual telecasting on the higher bands, as well as the v.h.f. channels. It was believed that during the transition period, the ultra-highs would certainly advance to a point where all of the shortcomings now present would disappear and u.h.f. transmission and reception would be comparable to current very-high service; perhaps improved, particularly insofar as noise problems are concerned. Present very-high area listeners would not suffer coverage loss, it was said, because extra ultra-high stations would begin operating and supply signal coverage originally available from fewer channel 2 to 13 stations.

Those favoring the plan say that the high-density population area in the eastern part of the country does not require broad very-high coverage; concentrated transmissions by many stations can do the job just as effectively, and u.h.f. can provide such service.

THE FIERY NETWORK-DOMINATION probe, underway in Washington for many months, was hit by a blockbust-

NEW TV GRANTS SINCE FREEZE LIFT

Continuing the listing of construction permits granted by FCC since lifting of freeze. Additional stations will be carried next month.

STATE	CITY	CALL	CHANNEL	FREQUENCY	POWER*
Idaho	Pocatello	———	6	82-88	69
Maine	Presque Isle	———	8	180-186	11.8
Nebraska	Omaha	———	7	174-180	39.45
New York	Elmira (Satellite)	———	18	494-500	15.4
Virginia	Bristol	———	5	76-82	100

NEW CALL LETTER ASSIGNMENTS

California	Redding	KVIP	7	174-180
California	Sacramento	KGMS-TV	46	662-668
Pennsylvania	Philadelphia	WSES	29	560-566
Kansas	Ensign	KTVC	6	82-88

CALL LETTER CHANGES

Colorado	Grand Junction	KREX-TV (formerly KFXJ-TV)	5	76-82
Colorado	Montrose	KFXJ-TV (formerly KREX-TV)	10	192-198
Ohio	Cleveland	WJW-TV (formerly WXEL)	8	180-186
New York	Albany	WCDA (formerly WROW-TV)	41	632-638
New York	Hagaman	WCDB (formerly WAST)	29	560-566

*ERP=(effective radiated power, kw.)

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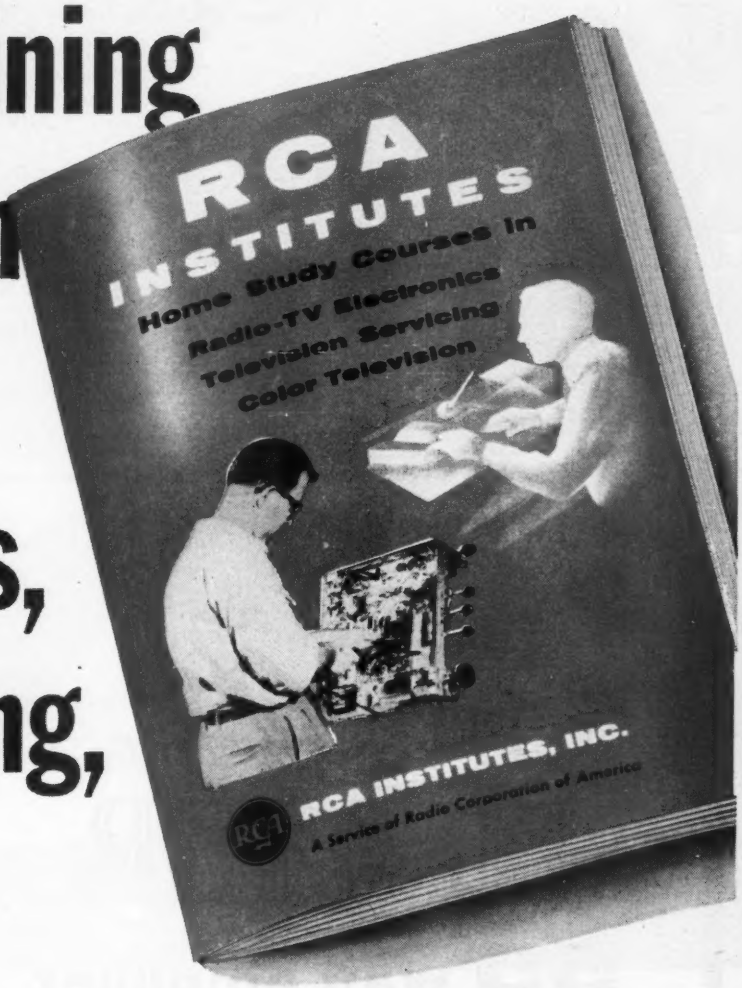

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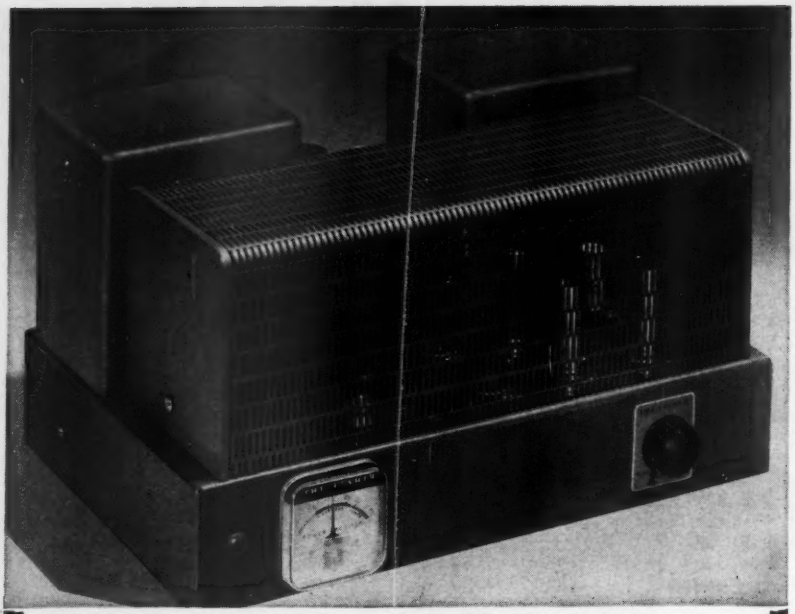

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55 Watt Amplifier

PLENTY OF POWER for your present — and any possible *future* needs. The new Model 55-A is a laboratory instrument designed for home use. Delivers 55 watts at less than 1% distortion — and handles 110-watt power peaks! Drives even the lowest efficiency loudspeaker system to full output. Exclusive FISHER POWER MONITOR, a full-size, illuminated Power Output Meter, makes possible correct adjustment of output tube bias. It also indicates average audio power. Completely new Z-MATIC Variable Damping Factor Control. Has *three times* the range of ordinary controls. Massive transformers, laced cable wiring, terminal board construction — all are in the FISHER tradition. **$169.50**

Outstanding Features of THE FISHER 55-A

■ Less than 1% harmonic distortion at 55 watts (0.05% at 5 watts, 0.08% at 10 watts.) ■ Handles 110 watts peak. ■ IM distortion below 0.4% at 10 watts (0.8% at 45 watts, 2% at 50 watts.) ■ Uniform response ±0.1 db 20 to 20,000 cps. (within 1 db, 5 to 100,000 cps.) ■ Power output constant within 1 db at 50 watts, 15 to 60,000 cps. ■ Hum and noise better than 92 db below full output! ■ Bias Control to balance output tubes. ■ Z-MATIC provides variable damping, from 32 to 0.08. ■ Less than 1 volt input produces full output. ■ Input Level Control. ■ 8 and 16-ohm output impedances. ■ Auxiliary AC receptacle. SIZE: 14¼"w. x 9⅜"d. x 8⅞" high. SHIPPING WEIGHT: 50 lbs.

Price Slightly Higher In The West

WRITE TODAY FOR COMPLETE SPECIFICATIONS

FISHER RADIO CORP. · 21-23 44th DRIVE · L. I. CITY 1, N. Y.

er report a few weeks ago, which came from the office of the former chairman of the Senate Interstate and Foreign Commerce Committee, Senator John W. Bricker, and bluntly tagged the networks as the . . . "yoke of economic dominance."

The Senator's essay, titled "The Network Monopoly," asked that the FCC be authorized to regulate the networks, and that service areas of existing v.h.f. stations in high-density zones be reduced, to protect market value, by lowering power and antenna heights.

Commenting on the profits made by the networks, the Senator said that the two major systems . . . "exercise a stranglehold over the entire industry."

A NEW TYPE OF RADIO TELESCOPE, a microwave spectroheliograph, will soon begin the task of exploring the sun's turbulent atmosphere, under the direction of the Air Research and Development Command's Air Force Office of Scientific Research.

Based on an idea conceived by members of Stanford University, the device will be used to pick up solar microwave radiations in the 3000-megacycle region. It will be located on the University's campus and employ 32 parabolic aluminum antennas, aligned in two rows to form a huge cross occupying a level, two-acre meadow.

As the dish antennas scan the sun's surface in the same way a TV camera scans its subject, the photographs produced show the *chromosphere,* a hitherto mysterious billowing layer of incandescence, rising to heights of 6000 miles above the sun's surface.

Although discovered many years ago at the time of solar eclipses, little is known about the chromosphere. The development of radio astronomy in the postwar era has renewed efforts to unveil its secrets. It is believed to have some connection with sunspots which, in turn, are related to magnetic storms which interrupt radio communications.

The elaborate network of 32 antennas will look straight at the sun, scanning its surface in unison and following automatically as it crosses the sky. A photograph of the entire solar orb will be completed in about two hours. Clouds, tests have shown, will not affect antenna efficiency.

An important accomplishment of the dish scanners will be the scanning of solar regions as small as three-thousandths of one square degree; a definition finer than ever before achieved in radio astronomy or in radar.

THE AIR RESEARCH AND DEVELOPMENT COMMAND has also announced the construction of the first trainer capable of teaching Air Force radar operators to guide their aircraft to a target, bomb the target and return, completely and solely with shoran (short-range navigation) radar.

Built at a cost of $100,000, the trainer offers radar operators complete instruction in the use of shoran radar

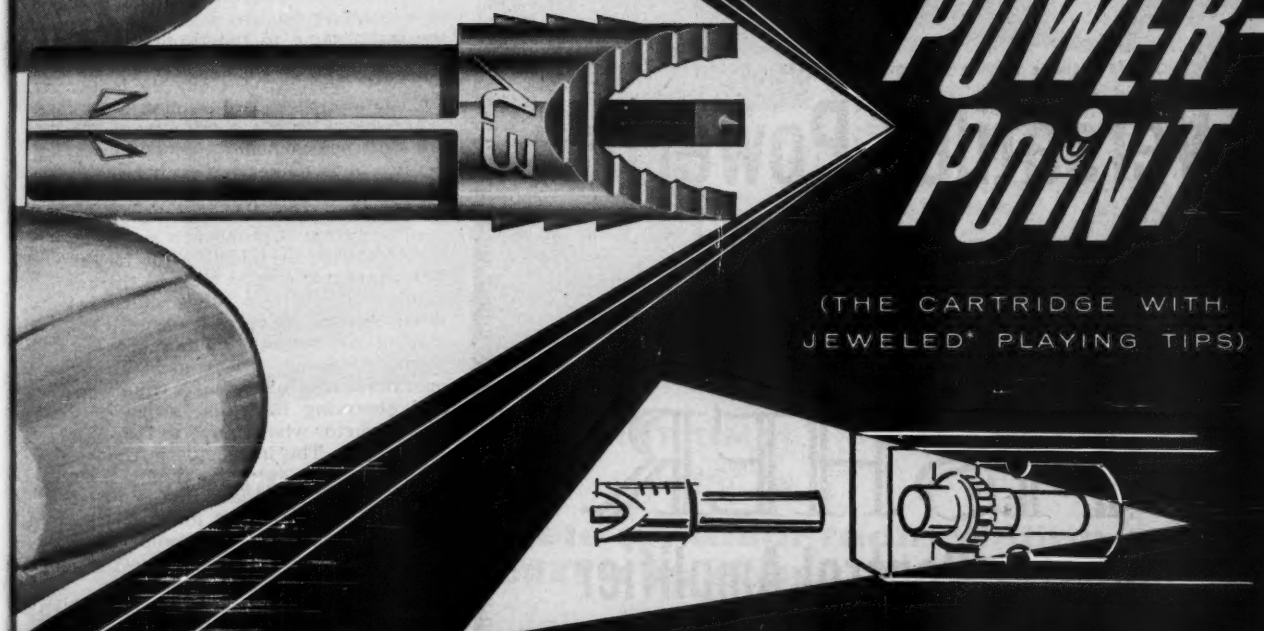
PROFIT COMES BACK!

to phono cartridge and needle market with

Electro-Voice®

POWER-POINT

(THE CARTRIDGE WITH JEWELED* PLAYING TIPS)



CUT INVENTORY COSTS
Power-Point Replaces over 90% of All Popular Phono Cartridges

REPLACE CARTRIDGE AND NEEDLE IN SECONDS
(Just Slip Out—Slip In)

E-V Power-Point actually gives you more working capital by cutting, drastically, the number of different cartridges and different needles you need in stock to do an adequate replacement business. Power-Point *alone* replaces over 90% of all popular phono cartridges. You save valuable time, troublesome service calls . . . you can replace Power-Point in less time than it takes to read this sentence! Remember too, almost a million Power-Points are now in use, and the number is growing fast. Additional millions will be demanded by the replacement market!

Four Power-Point Types, each $3.95 list

Model 51-1 (Red): two 1-mil sapphire tips.

Model 52-2 (Green): two 2-mil sapphire tips.

Model 53-3 (Black): two 3-mil sapphire tips.

Model 56 (Blue): turnover mounted 1-mil and 3-mil sapphire tips

Three Mounting Mechanisms

Model PFT-1 Power-Point Fixed Mount, 50c list.

Model PT-1 Power-Point Turnover Mount, $1.00 list.

Model PT-2 Power-Point Turnunder Mount, $1.00 list.

What is Power-Point?

A nylon-encased unit combining ceramic cartridge and two jeweled* playing tips. A Power-Point cartridge can be changed in seconds, replaces virtually all popular phono cartridges, costs less than two needles alone. It has low inertia, superior tracking ability, wide range, low distortion, minimum needle noise and record wear. It is non-inductive, hum-free, unaffected by moisture or temperature. It actuates all changer mechanisms.

*Superior synthetic sapphire or natural diamond.

MAIL COUPON TODAY!

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ELECTRO-VOICE, INC., BUCHANAN, MICHIGAN

Send me complete information about Electro-Voice Power-Point cartridges, sales-aids and display.

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Address _____

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Signed _____

THE WORLD'S PREMIER MASTER CONTROL AMPLIFIER • EQUIPPED WITH TONESCOPE

Versatile! Powerful!

THE FISHER

Master Control Amplifier

MODEL CA-40

COMPLETE IN EVERY respect — and it's by FISHER! Our *new* Model CA-40 Master Control Amplifier offers, on one compact chassis, the most advanced preamplifier with controls, as well as a powerful 25-watt amplifier with less than 1% distortion at full output. Among the many outstanding features of the CA-40 is another FISHER First — ToneScope, a graphic presentation of Tone Control settings. All this in a handsome, two-tone cabinet suitably designed both for table-top and shelf installation. THE FISHER CA-40 is the culmination of three years of intensive research and development and reflects in every respect the creative engineering that has made THE FISHER world-renowned.

$139.50

Leading Features of THE FISHER CA-40

■ Six inputs, including Tuner, Magnetic Phono, Mic and two Auxiliary. Input Level Adjustments. ■ Uniform response 10 to 90,000 cycles ± 0.5 db. Constant power within 1 db at 25 watts, 17 to 30,000 cycles. ■ 0.3 volts on high level, 0.005 volts on low level inputs produces full 25-watt output. ■ Less than 1% distortion at rated power. ■ Three-position Rumble and Noise Filters, with panel indicator lights. ■ Six equalization positions. ■ Direct tape-head playback. ■ Balanced Spectrum Bass and Treble Controls, providing 15 db boost or cut. ■ ToneScope: graph-form indication of Tone Control Settings. ■ 4, 8 and 16-ohm speaker outputs. ■ Cathode follower recorder output. ■ DC filament voltages on all low-level stages. ■ Shielded, shock-mounted construction. ■ CONTROLS: Bass, Treble, Main On-Off, Function Selector, Volume, 4-Position Loudness Contour, Rumble Filter, Noise Filter. SIZE: 12¾" wide x 10¾" deep x 5" high. ■ SHIPPING WEIGHT: 24 pounds.

Price Slightly Higher In The West

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under all simulated flight conditions. Adaptable to six types of shoran for bombing, photo reconnaissance and aerial mapping, the equipment uses short-range radar to navigate on bombing runs or to keep reconnaissance aircraft on the correct course while photographing.

The trainer, a complex affair, will enable the Air Force to do synthetically what it never could do in flight: chart the entire course and altitude of the shoran bombing run, and then study the data to pinpoint any errors that are made. Before this trainer was built, shoran training was done in actual flight where the only record of success or failure was how close the bomb came to the target. There was not, as there is now, any record to show where errors along the bombing course had caused a miss.

The heart of the shoran trainer is an electromechanical analogue computer, which makes it possible to set problem bombing runs, controlled by simulated shoran radar waves.

In operation, a problem is set up on the computer, establishing the target. The instructor acts as pilot of the imaginary aircraft and flies the simulated mission from a console. The student sits before a radar scope at a separate console. The student shoran operator, controlling his equipment and observing his radar scope, tells his instructor what course to follow to the target. The instructor introduces adverse effects into the flight, simulating enemy radar-jamming in any of six ways. The student must attempt to stop the jamming and properly direct his instructor so as to keep the aircraft on a precise course.

In the meantime, a large plotting board is charting the first portion of the bombing run. When the flight reaches the last five miles, the plotter switches to an expanded scale to give a highly detailed record of the final distance to the target, the automatic bomb release point and the strike of the bomb. The charted course is then studied and the student learns what mistakes he made, if any, and how to avoid them in the future.

FOR THE FIRST TIME, under lab conditions, man has produced temperatures of well over 400,000 degrees Fahrenheit and corresponding brightness 700 times greater than at the surface of the sun.

The incredible temperature and subsequent brightness are the result of investigations into the physics of high energy, high temperature and gaseous discharge by scientists of the ARDC.

Temperatures which have been measured by the lab are of exceedingly short duration, less than a millionth of a second, but an important outgrowth of this research was the design of equipment capable of accurately measuring the powerful and extremely fast pulsed electrical spark discharge.

The extremely high temperatures involve the release of electric energy

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For more than 22 years Hallicrafters has been closer to the radio amateur field than any other communications manufacturer. The many leading Hallicrafters developments have been based on what the amateur wanted and needed. The result of this close association is this radio man's ideal—the finest component units (Model SX-100 AM-CW-SSB receiver, Model HT-30 transmitter-exciter, Model HT-31 linear power amplifier) in a completely packaged radio station—

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a single package for

PROFESSIONAL EFFICIENCY

FEATURES

Here is a completely contained unit in a handsome console cabinet—transmitter/exciter, linear power amplifier, receiver affording the finest in V.F.O. or crystal. SSB, AM and CW transmission and reception. You need supply only the antennae, microphone and AC power. All the wiring is complete and external connections are provided for antennae and microphone.

The transmitting and receiving units are located in coordinated operation for maximum efficiency, and a special communications speaker is positioned above the operating shelf directly in front of the operator.

The mobile console is mounted on casters and is easily expandable. Three blank panels are also provided in the basic cabinet for the installation of any additional equipment that may be desired.

The console incorporates all safety and protective features. It is completely enclosed, fused with the main power relay controlled by a key lock. For "extra" safety, the entire back of the cabinet is enclosed but perforated for maximum ventilation and heat dissipation.

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2. Master power switch "key lock" type operates main power relay to turn on or off all equipment.
3. Main power pilot lamp.
4. "On the air" pilot lamp.
5. Microphone input.
6. Key jack.

REAR PANEL:

1. Five coaxial connectors for 80, 40, 20, 11-10 antenna and dummy load or special antenna.
2. Dual 30 ampere fuse block.
3. Three spare AC power outlets.
4. Spare octal socket for beam controls, etc.

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into a very small volume of inert gas under high pressure.

A specially designed capacitor circuit is employed to store the energy and release the electric discharge. This capacitor circuit, applied to the basic gaseous discharge technique, is primarily responsible for the resultant high temperatures.

In the past, those working in the field were unable to determine with accuracy the temperatures which they were able to generate. Now, because of the ARDC development, accurate measurement of the temperature and the brightness can be calculated.

DATA-PROCESSING shared by two interconnected electronic high-speed digital computers, the *Seac* and *Dyseac*, has been successfully performed in Washington at the labs of the Bureau of Standards.

The two computers designed and built at the Bureau worked cooperatively on a common task to demonstrate program-controlled machine intercommunication in which coordinated programs were read into both machines. The problem simulated a situation where stock-transaction reports are tabulated and summarized for fiscal accounting, and then forwarded for posting to inventory control records elsewhere. The experiments were carried out as part of a program with the Navy Bureau of Supplies and Accounts to investigate the application of electronic techniques to the problems of supply management.

Typical applications of digital computers as data processors involve replacement of many small specialized machines by a single automatic system. However, for massive paper-handling operations, or for large-scale activities requiring the processing of the same data for different purposes at different locations, the use of more than one high-speed data processor may be necessary. For instance, in the far-flung supply organizations of the armed forces, expediting flow of information is essential to efficient supply management. Automatic communication between machines has been foreshadowed by direct input and output provisions, so that the computer continues with other useful work, while transfers of information between it and external devices are in process, and by tape-processing devices where search is under the program control of a computer. In this example, however, the interconnection is between a computer serving as the nucleus of a processing system and other parts of the same computer system.

Most general-purpose electronic computers employ a generally compatible digital language, can receive and transmit data in the form of electrical signals by way of standard communication channels over any desired distance, and can alter the course of processing programs in accordance with new or revised information. It should therefore be possible to inter-

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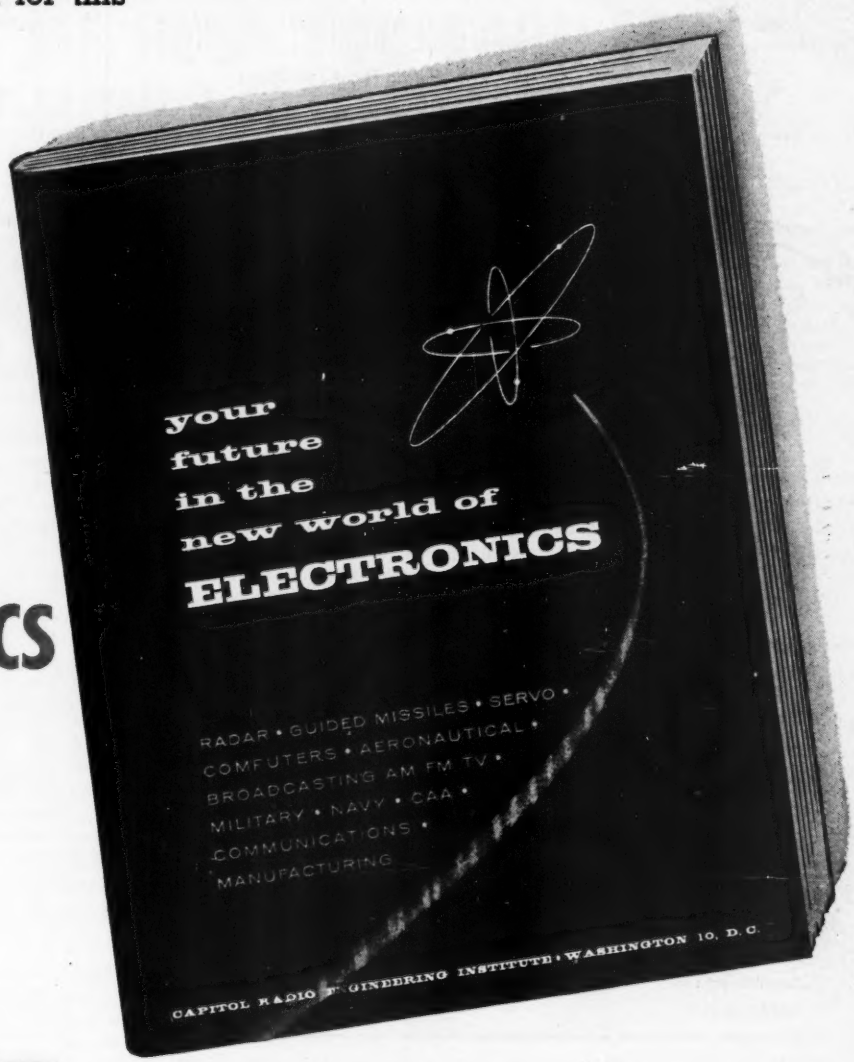

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Enjoy pleasant Florida living and working at these locations. Liberal company benefits. Relocation assistance.

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These positions are located on the Islands shown on the map above. Salary, 30% incentive, meals and lodging furnished. Return to U.S. every 3 months.

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Technical Employment, Dept. N-16G
Missile Test Project
RCA Service Co., Inc.
P.O. Box 1226, Melbourne, Florida

RCA RADIO CORPORATION of AMERICA

connect two or more general-purpose machines so that they can cooperate on a common task. For example, a versatile large-capacity data processor at a material control center might receive data fed to it automatically by smaller computers located at various supply depots. The supervisory processor (at the center) might so control the system-wide processing that it would accept data from each of its reporting sources in a scheduled sequence, but would also be free to accept and handle priority requests for supply action from any of the Armed Forces supply depots at any time.

For the kind of interaction where both information and exchanges of control are transferred between computers, the question of programmed control *versus* automatic interruption is particularly important. Programmed control depends, to a considerable extent, on human anticipation of when and how the interchanges should occur; however, if two or more systems are to interact automatically without human intervention, provision must be made for automatic interruption of a program in process in order to turn to the new information just received from another system. Such interruption properties are available from the *Dyseac* computer.

A cable between the *Seac* building and a trailer housing *Dyseac* provides interconnection through a regular input-output terminal on each machine. Information transfers were initiated and terminated by the transmission of control signals between the two machines. Whenever a *Seac* output instruction called for selection of the particular output used for transmission to *Dyseac,* a 62-volt preparatory signal was sent from the *Seac* external selector unit to *Dyseac.* This signal activated appropriate monitor operations in *Dyseac.* As soon as *Dyseac* was ready to accept the data, it transmitted a 62-volt signal to *Seac.* Only upon receipt of this signal was *Seac* able to proceed with its next instruction. In effect, *Seac* continued trying to complete this output instruction, until *Dyseac* signalled readiness to accept the transfer of the information *Seac* was holding for processing.

ONCE AGAIN, grants continued to move along; however, v.h.f. channels predominated in the approvals issued as we went to press, as the listing on page 14 reveals.

THE SPECTACULAR PERFORMANCES TV can provide will be on view this summer at the St. Lawrence power project near Massena, N. Y., when through the use of cameras and microwave television, tourists will be able to view construction work on the dams. TV cameras will be mounted on towers and rotated to cover an arc of operations. About 200 will be able to watch video pickups on three receivers at one time. A mighty tribute to TV's maturity. . . . . L. W.

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VETERANS

My School fully approved to train Veterans under new Korean G. I. Bill. Don't lose your school benefits by waiting too long. Write discharge date on coupon.

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FCC COACHING COURSE

Important for BETTER-PAY JOBS requiring FCC License! You get this training AT NO EXTRA COST! Top TV jobs go to FCC-licensed technicians.

EARN WHILE YOU LEARN

Almost from the very start of your course you can earn extra money by repairing sets for friends and neighbors. Many of my students earn up to $25 a week . . . pay for their entire training with spare time earnings . . . start their own profitable service business.

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"With RTTA training and through repairing radios and televisions for the right people at the right price, I was able to make the right contacts. I am now an Inspector for Douglas Aircraft at about $125 a week."

Hugh Maddox, Los Angeles, Calif. 4/30/54

$60 A WEEK IN SPARE TIME

"I have the skill and know-how to do the work I love best and to enjoy better things in life, thanks to RTTA. I am now working at TV servicing and making $60 a week spare time."

Harold Gimlen, Flint, Mich. 4/21/54

ASSISTANT MANAGER

"I am Assistant Manager of Day and Nite TV Service."

Ronald W. Curry, Tulsa, Okla. 1/2/55

EARNS EXTRA MONEY

"RTTA training gave me a chance for my own business, extra money earned, and more things that the price of the course could never equal."

Bryce Ruttle, Peterborough, Ontario, Can. 4/1/55

FEELS FULLY QUALIFIED

"With your training I feel fully qualified to get out and compete with all radio mechanics in this area. I have over $1,500 invested in test equipment, $1,000 in tube stock and $200 in miscellaneous equipment. Since I haven't had one complaint in 9 months I have been servicing sets, your school must have done a good job."

Jim Martin, Collinsville, Ill. 3/17/55

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THE BASIC 9 LESSONS

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ALL OF THIS MODERN, NEWEST, PRACTICAL EQUIPMENT IS YOURS TO KEEP!

- Parts to Build a modern TV set, including large screen Picture Tube.
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YOU DO MANY PRACTICAL JOBS. You do servicing, circuit analysis and many other down-to-earth experiments. You build a modern TV set from the ground up . . . with equipment kits we give you, including a new large screen picture tube and professional Multitester, at no additional charge.

EARN AS YOU LEARN! Many of our students earn their entire tuition and more in Spare Time jobs we show them how to do while learning. YOU GET GRADUATE ADVISORY SERVICE, TOO.

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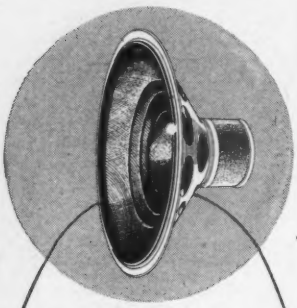

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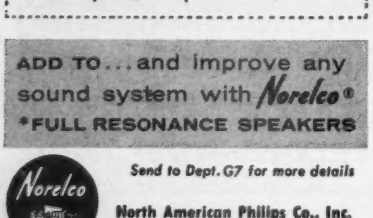

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Within the Industry

WILLIAM T. WARRENDER, manager of the tube plant of *RCA* Tube Division at Marion, Indiana, has been appointed general manager of the recently-created *RCA* Components Division, with headquarters at Camden, N. J.

Mr. Warrender entered the electronics field in 1925. After 11 years as factory engineer with several tube manufacturing firms he joined *RCA* in 1936 at Harrison. A year later, he was transferred to the company's Indianapolis factory with responsibilities that included factory engineering and production control. In 1942 he was made superintendent of production and was named department manager in 1944.

He became manager of the Marion plant when *RCA* acquired the property in 1949.

* * *

SHURE BROTHERS, INC. has moved into a new building located at 222 Hartrey Avenue in Evanston, Illinois. The million-dollar plant was planned and custom-built for maximum efficiency in the research, development, and manufacturing of microphones, phono cartridges, magnetic tape recording heads, and other acoustical electronic products . . . **SNYDER ANTENNA ENGINEERS, INC.** has opened a warehouse at 2724 Leonis Boulevard in Los Angeles to serve the West Coast area customers for *Snyder* antennas . . . **ARROW ELECTRONICS, INC.** has moved its industrial department to larger quarters at 525 Jericho Turnpike, Mineola, Long Island. The new location provides over 117,000 cubic feet of warehouse space . . . **MINNEAPOLIS-HONEYWELL REGULATOR COMPANY** is moving its transistor division from Minneapolis to the Boston area . . . **CLAREMONT TUBE CORPORATION** has established a picture tube warehouse at 1600 W. Luzerne Street, Philadelphia . . . **SANDS ASSOCIATES, INC.** has opened a new office in Palo Alto at 535 Ramona Street . . . **ORRADIO INDUSTRIES** is building the nation's first plant designed expressly for the manufacture of magnetic recording tape for sound-and-color TV and electronic brain computers. The $300,000 plant will increase the Opelika, Alabama, firm's capacity by 400 per-cent. Completion is scheduled for October . . . **AUDIOFAX ASSOCIATES, INCORPORATED,** engineering design service organization for the professional audio field, has recently moved its laboratory and store to Stony Brook, Long Island, New York . . . **B & R ELECTRONICS CO.** and **ELECTRONIC CREATIONS CO., INC.** have moved their offices and factories to a new plant at 1178 East 180th Street, New York, N. Y. The 30,000 square foot plant will enable the firms to increase production on their lines of phonographs, radios, record players, etc. . . . **TRANSITRON, INC.** has moved its operations from New York to a modern 100,000 square foot plant in Manchester, New Hampshire . . . The Semiconductor Sales Department of **RADIO RECEPTOR COMPANY, INC.** has moved to 240 Wythe Avenue in Brooklyn, N. Y. . . . **SUPREME PUBLICATIONS** has closed its Chicago office and consolidated operations at its warehouse at 416 W. Huron Street in Chicago and at its Highland Park facilities . . . **GENERAL PRECISION LABORATORY INCORPORATED** has broken ground for a 23,200 square foot plant at Pleasantville, New York, to house its environmental test laboratory. The building is expected to be in operation late this year.

* * *

SIDNEY HARMAN, president of *Harman-Kardon, Inc.,* has been elected chairman of the Sales Managers Club, succeeding Charles Golenpaul, vice-president of *Aerovox Corporation.*

Harry Estersohn of the *Jerrold Electronics Corp.,* Philadelphia, was elected vice-chairman. Walter Jablon, *Presto Recording Corp.,* was elected secretary-treasurer.

The Sales Managers Club was organized in 1937 and has operated as the electronics manufacturers' trade association without interruption for almost 20 years. It is one of the three national organizations which sponsor the annual Radio Parts and Electronic Equipment Show held in Chicago each May.

* * *

JAMES M. SKINNER, JR. has been elected president of *Philco Corporation,* succeeding **JAMES H. CARMINE,** who retired recently . . . **SAUL J. WHITE** has joined *Racon Electric Co., Inc.,* as chief engineer. He was formerly with *University Loudspeakers* . . . **JOE C. HARMONY** has been named manager of receiving tube operations at *CBS-Hytron* . . . **FRANK C. ENGELHART,** president of *Kester Solder Company,* was recently honored on the occasion of his 75th birthday and his 47th anniversary with the company . . . **WILLIAM E. BARBOUR, JR.** was elected chairman of the board and **WILLIAM**

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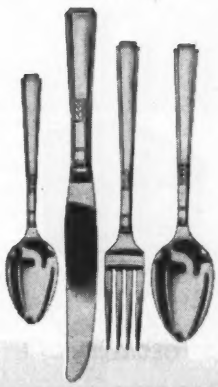
*Earn the complete 54-piece set in the smart anti-tarnish chest

exclusive *Capri*

triple silverplate by Wm. A. Rogers



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When you need only 5 Sylvania tokens for a complete 4-piece setting, in no time at all you can earn a complete set of *Capri* triple silverplate.

Capri is an exclusive Wm. A. Rogers design of Oneida Limited, Silversmiths.

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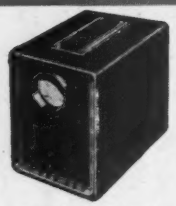
BEST FOR COLOR TEST!

There's just one way to test the new color TV sets... WITH NTSC COLOR PATTERN. That's what Hycon's Model 616 Color Bar/Dot Generator offers...*all* standard colors, sequences and patterns easily selected and graphically shown *in actual color* right on the control panel. For color TV, get ready... GET HYCON!



MODEL 617
3" OSCILLOSCOPE

The most for your scope dollar. Flat-face CRT gives edge-to-edge accuracy... laboratory precision *plus* field ruggedness. And at your electronic jobber, it's just... $269.50.

"Where Accuracy Counts"

Hycon ELECTRONICS, INC.

A Subsidiary of Hycon Mfg. Company

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PASADENA, CALIFORNIA

MAIL, please, for Catalogs 616 and 617

HYCON ELECTRONICS, INC. Dept. U
P.O. Box 749 Pasadena, California
Please send me the new model 616 and 617 catalogs.

Name_____

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O. FAXON was named president of *Tracerlab, Inc.* by the board of directors . . . **STERLING M. GARDNER,** founder of the *Gardner Electric Manufacturing Co.,* passed away recently in California. He was 70 years old . . . **WILLIAM A. SHAW** has been named sales manager of *Hallicrafters* home radio and television department. He has been with the firm for over ten years, most recently as national servicing manager . . . **ALBERT COUMONT** has joined *Sprague Products Company* as assistant to the president. He recently resigned as service coordinator of the RETMA . . . **FRANK APPLE** is the new advertising manager of *Centralab* . . . **WILLIAM B. DEAN** has been named president of *New England Industrial Center* in Needham Heights, Mass. He was formerly general manager of the industrial department of *DeMambro Radio Supply Co., Inc.* of Boston . . . **DR. ROBERT B. CORBY** has been appointed to the engineering staff of *Trio Laboratories, Inc.* . . . *Emerson Radio and Phonograph Corporation* has named **HARRY SCHECTER** to the post of vice-president in charge of distribution. He was formerly with *CBS-Columbia* . . . **MATTHEW N. CINELLI** has been appointed manager of quality control for the television-radio division of *Westinghouse.* He will make his headquarters in Metuchen, N. J. . . . **DR. ALLEN M. PETERSON** will head the newly-formed special techniques group in Stanford Research Institute's Engineering Division . . . **DAVID SOLOMON** has been named cooperative advertising manager for *CBS-Columbia.* He will be responsible for the planning, operation, and administration of the firm's national distributor cooperative advertising program in all media . . . **CHARLES M. SCHWAB** has been named general manager of the Puerto Rico plant of *Phillips Control Corp.,* Joliet, Illinois, manufacturer of relays, solenoids, and control devices.

* * *

HAROLD H. KNUBBE, director of engineering for *CBS-Columbia,* has been promoted to the post of director in charge of all engineering and developmental activities at the company.

In his new post, Mr. Knubbe will supervise radio, black-and-white TV, color television, and industrial electronic engineering activities. He has been active in the electronics industry for the past twenty-four years. Before joining the company in 1952, he was chief engineer for *Sparton.* He was also associated with *General Instrument Corporation* and the *Detrola Radio Corporation,* among other electronic firms.

* * *

BAIRD ASSOCIATES, INC. and **ATOMIC INSTRUMENT COMPANY,** both of Cambridge, Mass., have merged in order to take maximum advantage of produc-

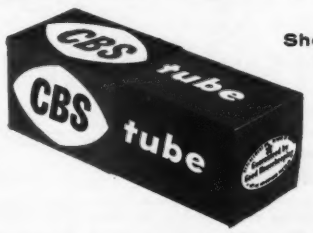
who sells Mrs. America?

Garry Moore, that's who!
He sells her because she likes him and has confidence in him. Nearly five million of her watch and listen to him weekdays on the CBS

Television Network. She *believes* what Garry says about his sponsors' products. And she buys them.

As a CBS tube dealer, you . . . yes, you . . . are one of Garry Moore's sponsors. He tells your customers that there are no better tubes made than your CBS tubes, and that they have the Good Housekeeping Guaranty Seal. He also tells the ladies about your technical training and equipment, and why they can rely on your expert service.

So remember, when you call at Mrs. America's home to repair her TV set, you . . . and CBS tubes . . . are welcome because Garry Moore has already convinced her that she can have confidence in both you and CBS tubes.



Show her the CBS carton with the Good Housekeeping Guaranty Seal.

Guaranteed by Good Housekeeping

CBS-HYTRON
Danvers, Massachusetts
A Division of Columbia Broadcasting System, Inc.

SAD?

because you weren't able to get your

1956 Radio Electronic MASTER

Sorry you were disappointed. In many areas, there just weren't enough MASTERS to meet the demand.

But — cheer up. If you act fast, we can help you get your industry-wide buying guide. We've located several distributors with extras on hand.

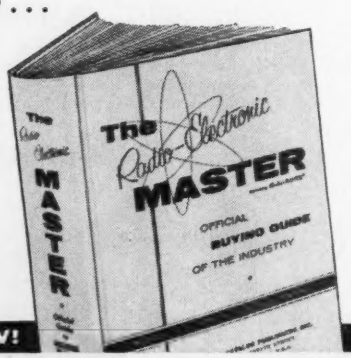
And what's more . . . you'll only pay the $2.95 distributor price instead of the regular $7.50.

- 100,000 items
- Complete descriptions
- Specifications—Prices
- 11,000 illustrations
- 8 x 11", 6 lbs.
- 350 mfrs.

So send your coupon now . . . first-come—first-served.

1450-Page Buying Guide . . . helps you shop before you buy. The supermarket pages of The MASTER enable you to compare specs and prices first — then buy and save.

A Gold Mine of Facts . . . on all the latest products and models . . with changes in specs. It's all in The MASTER catalog file of the electronic parts industry.



MAIL COUPON NOW!

UNITED CATALOG PUBLISHERS, INC., 110 LAFAYETTE ST., NEW YORK 13, N. Y.

Here's my $2.95. Please rush me the 1956 MASTER, Official Buying Guide of the Electronic Parts and Equipment Industry.

Name.....

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RN-7

tion and sales efficiencies resulting from such an operation . . . **AMERICAN PHENOLIC CORPORATION** has changed its corporate name to **AMPHENOL ELECTRONICS CORPORATION** to retain the company's familiar tradename . . . . . **STROMBERG-CARLSON** has discontinued the manufacture of television receivers but will continue in the consumer products business with a complete line of radio-phonographs and high-fidelity equipment.

* * *

ANDRE G. CLAVIER, vice-president and technical director of *Federal Telecommunication Laboratories,* Nutley, New Jersey, was recently honored for his pioneering efforts in microwave research.

The occasion marked the 25th anniversary of the historic experiment which took place on March 31, 1931, when a group of *I T & T* scientists established the world's first microwave circuit which extended across the English Channel between Dover and Calais.

Mr. Clavier was presented with a scale model of the parabolic antenna used during the historic demonstration. He joined the *I T & T* system in 1929 when he became affiliated with *Les Laboratories Standards,* the company's Parisian subsidiary.

* * *

CROWELL-COLLIER PUBLISHING CO. has purchased four TV stations and five radio stations subject to final approval of the FCC and the boards of directors of the various stations involved.

The new properties include television stations WTCN-TV (Minneapolis), WFBM-TV (Indianapolis), WOOD-TV (Grand Rapids), and KULA-TV (Honolulu) and radio stations WTCN (Minneapolis), WFBM (Indianapolis), WFDF (Flint), WOOD (Grand Rapids), and KULA (Honolulu).

* * *

HAROLD A. JONES has been promoted to the post of national sales manager of *Motorola Communications and Electronics, Inc.* He was formerly executive assistant to the national sales manager, Eugene S. Goebel, who recently was named vice-president for market relations for the firm's division.

In his new capacity, Mr. Jones will have responsibility for implementing sales policy as well as executing sales planning and sales promotion. The function also includes sales training, advertising, and technical information services.

An electrical engineering graduate of Northwestern University, he joined the company in 1946 as a television receiver engineer. —30—

World's Finest High Fidelity Tuners

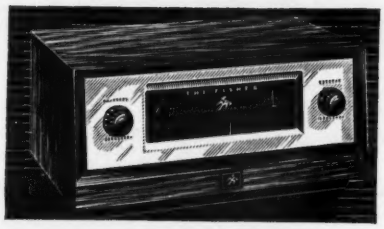
THE FISHER

■ Engineered for the professional, functionally designed for the home, THE FISHER Tuners are characterized by extreme sensitivity, micro-accurate tuning and precision workmanship throughout.

FISHER FM TUNER · Model FM-40

■ A compact, beautifully designed instrument at moderate cost, for discriminating users. Stable circuitry and simplified controls make this remarkable tuner exceptionally easy to use. Meter for micro-accurate, center-of-channel tuning. Sensitivity: 3 microvolts for 20 db quieting. Supplied with folded dipole but can accommodate 300 or 72-ohm antenna systems. Drift-free circuit has three outputs: Cathode follower, Detector and Multiplex. Eight tubes, self-powered. Handsome brushed-brass panel for top appearance. SIZE: 12¾" wide x 7¼" deep x 4" high. WEIGHT: 15 pounds. *Mahogany or Blonde Cabinet Available.*

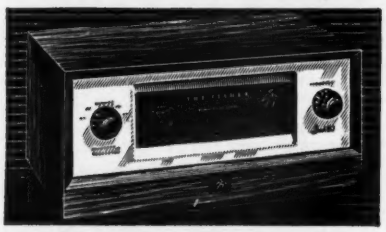
Chassis $99.50 · Cabinet $14.95



FISHER FM TUNER · Model FM-80

■ Equipped with *two meters*, the FM-80 outperforms any existing FM tuner. Combines extreme sensitivity, flexibility, and micro-accurate tuning. Unusually compact, exceptionally engineered chassis. Armstrong system, two IF stages, dual limiters, cascode RF stage. *Full* limiting even on signals as weak as *one* microvolt! 72 and 300-ohm antenna inputs. *Completely* shielded and shock-mounted. THREE CONTROLS: Variable AFC/Line Switch, Sensitivity, and Station Selector. Two bridged outputs, cathode follower type. 11 tubes. Brushed-brass control panel. Self-powered. SIZE: 12¼" x 7¼" x 4" high. WEIGHT: 13 pounds. *Mahogany or Blonde Cabinet.*

Chassis $139.50 · Cabinet $14.95



FISHER AM TUNER · Model AM-80

■ This is the high quality AM counterpart of the famous FM-80 Tuner described above. It combines the pulling power of a professional communications receiver with the broad tuning necessary for high fidelity reception. Designed to rigid standards, featuring a tuning meter for micro-accurate station selection. Three-position adjustable band width. Extreme sensitivity—less than *one* microvolt produces maximum output! Elusive and distant stations are brought in with ease. Three inputs, cathode follower output. Eight tubes. Self-powered. SIZE: 12¼" wide x 7¼" deep x 4" high. WEIGHT: 15 pounds. *Mahogany or Blonde Cabinet Available.*

Chassis $139.50 · Cabinet $14.95

FISHER FM-AM TUNER · Model 80-R

■ Acclaimed everywhere as the finest FM-AM tuner available. Works where others fail! Has two meters for micro-accurate tuning, features extreme sensitivity—1.5 microvolts for 20 db quieting! Adjustable AFC and AM selectivity, separate FM and AM front ends. Shock-mounted chassis, super-smooth flywheel tuning. Completely shielded construction used throughout. Response within 0.5 db from 20 to 20,000 cycles. Distortion below 0.04% for 1 volt output. Cathode follower and Multiplex outputs. Handsome, brushed-brass control panel. SIZE: 12¾" wide x 8¾" deep x 4" high. WEIGHT: 16 pounds. *Mahogany or Blonde Cabinet Available.*

Chassis $169.50 · Cabinet $17.95

FISHER FM-AM TUNER · Model 80-T

With Preamplifier and Complete Audio Controls

■ Unequalled among FM-AM tuners with controls. Model 80-T is identical to Model 80-R but has built-in Preamplifier-Equalizer. It uses TWO meters, for center-of-channel indication and signal strength. Extreme sensitivity—1.5 microvolts for 20 db quieting. Adjustable AFC, adjustable AM selectivity. Designed with separate FM and AM front ends. Response 20 to 20,000 cycles, within 0.5 db. At one volt output distortion is less than 0.4%. Contains phono *and* tape-head preamplifier, with full equalization controls. Three inputs, two outputs, including Multiplex. 16 tubes. EIGHT CONTROLS: Selector, Variable AFC/Line Switch, Station Selector, Bass, Treble, Equalization, Volume, 4-Position Loudness Balance. SIZE: 12¾" wide x 8¾" deep x 6" high. WEIGHT: 21 pounds. *Mahogany or Blonde Cabinet Available.*

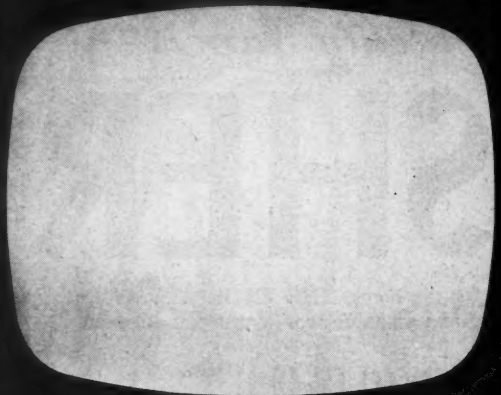
Chassis $199.50 · Cabinet $17.95

Prices Slightly Higher in the West

WRITE TODAY FOR COMPLETE SPECIFICATIONS

FISHER RADIO CORPORATION · 21-23 44th DRIVE · L. I. CITY · N. Y.

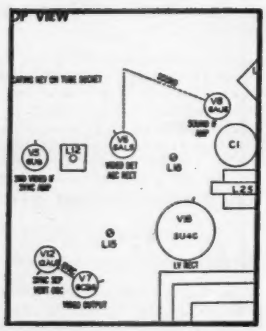
how long would it take you to solve this service problem?



SYMPTOM:

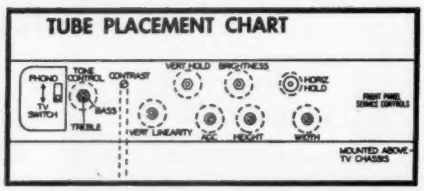
No picture is obtained. Sound is distorted. Raster is okay.

There's no telling how long it might take to solve this problem with hit-or-miss methods or incomplete service data. With a PHOTOFACT Folder by your side, the job takes just minutes. Here's why:

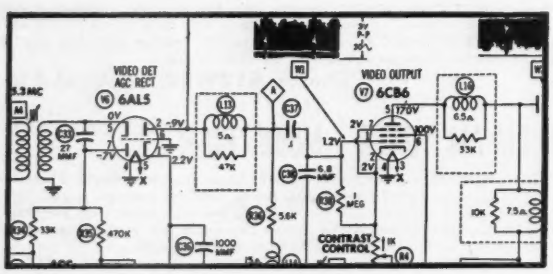


1. In just seconds, you locate the tubes most likely to cause this symptom by referring to the Tube Placement Chart* and Tube Failure Check Chart* you'll always find in each PHOTOFACT TV Folder.

In this case the trouble wasn't caused by tube failure. So checking further...



2. Adjustment of the AGC Control caused a weak picture to appear. Operation of the contrast control had no effect (control identification and location appear right on the Tube Placement Chart*). Next logical step:



3. In just seconds, you refer to the Video and AGC circuits on the Standard Notation Schematic* featured exclusively in PHOTOFACT Folders. (Circuits are always laid out in the same uniform manner—easy to locate—easy to trace.) In a matter of minutes, you check waveforms and/or voltages—they're right on the schematic. In those same few minutes, you pinpoint the trouble. You make a resistance check using the handy Resistance Chart* and you have the answer to your problem in this case history: A cold solder connection at the center lug of the Contrast control.

*One of 32 features found exclusively in PHOTOFACT—the world's finest service data—the data that gives you the most for your money.

With PHOTOFACT by your side, you solve your service problems in just minutes—you service more sets and earn more daily!

MONEY BACK GUARANTEE!

Got a tough repair? Try this—at Howard W. Sams' own risk: see your Parts Distributor and buy the proper PHOTOFACT Folder Set covering the receiver. Then use it on the actual repair. If PHOTOFACT doesn't save you time, doesn't make the job easier and more profitable for you, Howard W. Sams wants you to return the complete Folder Set direct to him and he'll refund your purchase price promptly. GET THE PROOF FOR YOURSELF—TRY PHOTOFACT NOW!

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Send for Sams' INDEX TO PHOTOFACT FOLDERS—your guide to virtually any receiver model ever to come into your shop; helps you locate the proper PHOTOFACT Folder you need to solve any service problem on any model. You'll want this valuable reference guide. Send coupon now.

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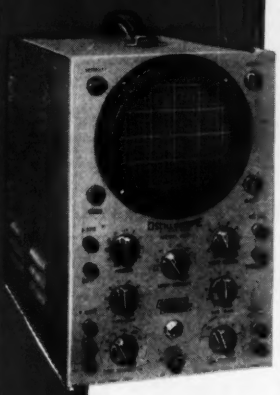
NEW! COLOR and Black-&-White LAB & TV 5" OSCILLOSCOPE #460

KIT $79.95. Wired $129.50



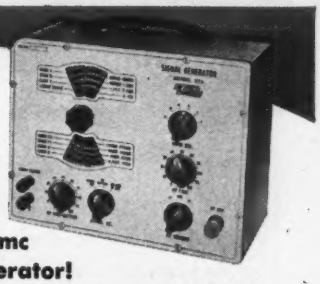
The FINEST professional 5 mc wide-band scope value. Ideal for research, h-f & complex waves, plus Color & Monochrome TV servicing. Flat from DC to 3.58 mc ±1 db (color burst freq.), flat DC to 4.5 mc +1, −3 db. Vert. sens. 25 rms mv/in. Vert. Z 3 megs. Has the following outstanding features not found in scopes up to several times its price, kit or wired:

VERTICAL AMPLIFIER: direct-coupled (DC) thruout to eliminate l-f phase shift; **push-pull thruout** for negligible distortion; **K-follower coupling** between push-pull pentode stages for extended h-f resp. (minimizes h-f phase shift, extends useful resp. to 10 mc); full-screen undistorted vert. defl; 4-step freq-compensated decade step attenuator up to 1000:1. **SWEEP CIRCUIT:** perfectly linear sweeps, 10 cps – 100 kc (ext. cap. for down to 1 cps); **pre-set TV vert. & hor. positions** (30 & 7875 cps); automatic sync. ampl. & limiter eliminates sync amplitude adj. **PLUS:** direct or cap. coupling; bal. or unbal. inputs; edge-lit engraved lucite graph screen; dimmer; anti-glare filter; bezel fits std photo equipt. **OTHER IMPORTANT FEATURES:** High intensity trace CRT. Finest sq. wave resp. (.06 usec rise time). Push-pull hor. ampl., flat to 400 kc, sens. 0.6 rms mv/in. Built-in voltage calibration. Intensity mod. Sawtooth & 60 cps outputs. Astigmatism control. Retrace blanking. Instant, drift-free full-screen vert. positioning & 2X full-screen hor. positioning. **Bal., cal., astig. adj. externally accessible.** 5UP1 CRT, 2–6AU8, 2-6CB6, 1-12AU7A, 2-6J6, 1-6AX5, 1-1V2. Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet. Designed for easy building at home with no special equipment. 13" x 8½" x 16". 30 lbs.

SCOPE DIRECT PROBE* #PD: KIT $2.75. Wired $3.95. Eliminates stray-pick-up & signal re-radiation.

SCOPE DEMODULATOR PROBE* #PSD: KIT $3.75. Wired $5.75. Demodulates AM carriers between 150 kc and 250 mc.

SCOPE LOW CAPACITY PROBE* #PLC: KIT $3.75. Wired $5.75. For signal tracing in high frequency, high impedance & wide-band circuits (as in TV) without distortion from overloading or frequency discrimination.



150 kc to 435 mc with ONE generator!

New! RF SIGNAL GENERATOR #324

KIT $26.95. Wired $39.95

for COLOR and Monochrome TV servicing

New wide-range, stable generator – better value then generators selling at 2 or 3 times its cost! Ideal for: IF-RF alignment, signal tracing & trouble-shooting of TV, FM & AM sets; marker gen.; 400 cps audio testing; lab. work. 6 fund. ranges: **150-400 kc, 400-1200 kc, 1.2-3.5 mc, 3.5-11 mc, 11-37 mc, 37-145 mc; 1 harmonic band 111-435 mc. Freq. accurate to ±1.5%;** 6:1 vernier tuning & excellent spread at most important alignment freqs. Etched tuning dial, plexiglass windows, edge-lit hairlines. Colpitts RF osc., directly plate-modulated by K-follower for improved mod. Variable depth of int. mod. 0-50% by 400 cps Colpitts osc. Variable gain ext. mod. amplifier: only 3.0 volts needed for 30% mod. Turret-mounted coils slug-tuned for max. accuracy. Fine & Coarse (3-step) RF attenuators. RF output 100,000 uv; AF sine wave output to 10 volts. 50-ohm output Z. 5-way jack-top binding posts for AF in/out; coaxial connector & shielded cable for RF out. Tubes: 12AU7, 12AV7, selenium rectifier; xfmr-operated. Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet. 8" x 10" x 4¾". 10 lbs.

The specs are the proof...

4 NEW BEST BUYS by EICO

for COLOR and Monochrome TV servicing

New! PEAK-to-PEAK VTVM #232 & UNI-PROBE (pat. pend.)

KIT $29.95. Wired $49.95

UNI-PROBE: exclusive with EICO! Terrific time-saver! Only 1 probe performs all functions—a half-turn of probe-tip selects DC or AC-Ohms.

The new leader in professional peak-to-peak VTVMs. Latest circuitry, high sensitivity & precision, wide ranges & versatility. **Calibration without removing from cabinet.** New balanced bridge circuit. High Z input for negligible loading. 4½" meter, can't-burn-out circuit. **7 non-skip ranges on every function.** 4 functions: +DC Volts, −DC Volts, AC Volts, Ohms. Uniform 3 to 1 scale ratio for extreme wide-range accuracy. **Zero center.** One zero-adj. for all functions & ranges. **1% precision** ceramic multiplier resistors. Measure **directly** peak-to-peak voltage of complex & sine waves: 0-4, 14, 42, 140, 420, 1400, 4200. DC/RMS sine volts: O-1.5, 5, 15, 50, 150, 500, 1500 (up to 30,000 v. with HVP probe, & 250 mc with PRF probe). Ohms: 0.2 ohms to 1000 megs. 12AU7, 6AL5, selenium rectifier; xfmr-operated. 8½" x 5" x 5". Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet. 7 lbs.

New! DELUXE PEAK-to-PEAK VTVM #249 with 7½" METER & UNI-PROBE (pat. pend.)

KIT $39.95. Wired $59.95

All the advanced & exclusive features of #232—PLUS the extra convenience and readability of its big 7½" meter. Your ideal bench instrument.

VTVM RF PROBES* #PRF-11 or PRF-25: KIT $3.75. Wired $4.95. Accuracy ±10%. Use with any 11 or 25 megohm VTVM.

VTVM HV PROBE #HVP-2: Wired $4.95. Complete with multiplier resistor. Measures up to 30 kv with any VTVM or 20,000 ohms/volt VOM.

COMPLETE with Preamplifier, Equalizer and Control Section

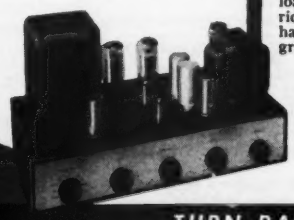
New! 20-WATT Ultra-Linear Williamson-type HIGH FIDELITY AMPLIFIER #HF20

KIT $49.95. Wired $79.95

A low-cost, complete-facility amplifier of the highest quality that sets a new standard of performance at the price, kit or wired. Every detail, down to the etched, brushed solid brass control plate, is of the fine quality EICO is famous for.

Rated power output: 20 watts (34 w peak). **IM distortion (60 cps: 6 ke/4:1) at rated power:** 1.3%. **Mid-band harmonic distortion at rated power:** 0.3%. **Maximum harmonic distortion between 20 and 20,000 cps at 1 db under rated power:** approx. 1%. **Power response (20w):** ±0.5 db 20-20,000 cps; ±1.5 db 10-40,000 cps. **Frequency response (¼w):** ±0.5 db 13-35,000 cps; ±1.5 db 7-50,000 cps.

5 feedback equalizations for LP's & 78's including RIAA. Variable turnover feedback tone controls do not affect volume & permit large boosts or cuts at either end of audio spectrum with mid-freqs. unaffected. Loudness control & separate level set control on front panel. Low Z output to tape recorder. 4 hi-level switched inputs: tuner, tv, tape, auxiliary (xtal/ceramic phono or 2nd tuner); 2 low-level inputs for proper loading with all leading magnetic, FM & quality xtal cartridges. Hum bal. control. Extremely fine output transformer has interleaved windings, tight coupling, careful balancing & grain-oriented steel. 8½" x 15" x 10". 24 lbs.

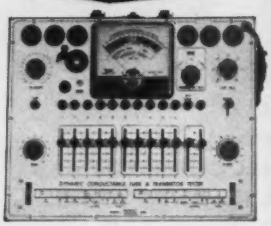


These amazing EICO values are **NOW IN STOCK** at your nearest distributor. Examine them side-by-side with **ANY** competitor. You'll see for yourself why indeed EICO is your **BEST BUY.** Fill out coupon on reverse page.

EICO

TURN PAGE FOR MORE EICO VALUES...

the specs are the test that tells who's best!



for COLOR & Monochrome TV servicing

NEW! DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666

KIT $69.95 WIRED $109.95

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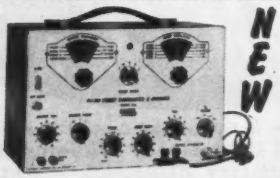

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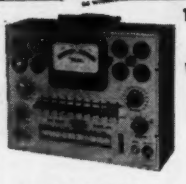

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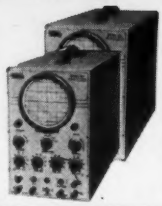

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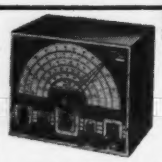

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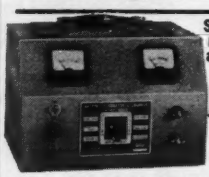

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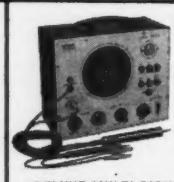

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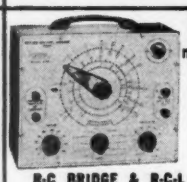

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PORTABLE TV

By
WALTER H. BUCHSBAUM
Television Consultant
RADIO & TELEVISION NEWS

Portable TV sets can be used anywhere in the house. They are easy to carry and most of them, like the Admiral shown here, will come equipped with an indoor antenna.

This is the hottest item on the black-and-white TV market. Why are they popular and what are their repair problems?

WITH well over 33 million TV receivers in American homes, the major set manufacturers have suddenly decided to mass produce small, low-cost receivers with screen sizes reminiscent of the early days of TV. They are doing this despite the emphasis in TV sales of replacing the early small-screen sets with 21-inch receivers. Yet, the appearance of the new small-screen receivers is the result of careful market studies and tests by the leaders of the TV industry who found that a market for "personal" or portable TV sets exists in areas receiving several channels. The program preferences of various members of the family, especially the younger set, often lead to the decision to buy a second set. Men or women living alone, bedridden people, travellers, and a host of others apparently see no great merit in buying a large-screen set if they can get a cheaper, small-screen set which is just large enough for close-up viewing.

Assuming that the major manufacturers are correct in their estimate of the demand for small, low-cost TV sets, how will this development affect the service operator?

While no one can foretell the full impact of this development, certain new factors can safely be predicted. For one, the customer will object to the cost of repairing these sets even more than he does for his present large-screen set since the original purchase price for the portable model is usually lower. This is reminiscent of the prewar radio servicing days when the customer often refused to pay a legitimate $6.00 repair charge on the grounds that the whole set had cost only $9.95. Yet, the actual service costs for a small-screen portable set may be higher than for a more elaborate console. The reasons are that the portable may get rougher handling, have less expensive components, develop more heat per volume, and be subject to great variations in temperature.

Most of these small-screen sets will probably not require installation by a technician since, if it is used as a second or third set in the home, the portable will be connected to an existing antenna and only a coupler is needed. In many other instances, the set will be operating from an indoor antenna. It is doubtful that many of these sets will be sold in weak signal areas because most portable sets do not have the full gain-bandwidth capability usually found in larger models.

Design Features

Although it may appear that the new small-screen TV receivers are really portable, they are actually only transportable, since they will not play while being carried by the viewer as is the case with portable radios. At the time of writing, no battery powered TV set has been put on the market.

Power supplies vary greatly among the new portable receivers. Some sets, like the *Setchell Carlson* model shown in Fig. 2, have regular power trans-

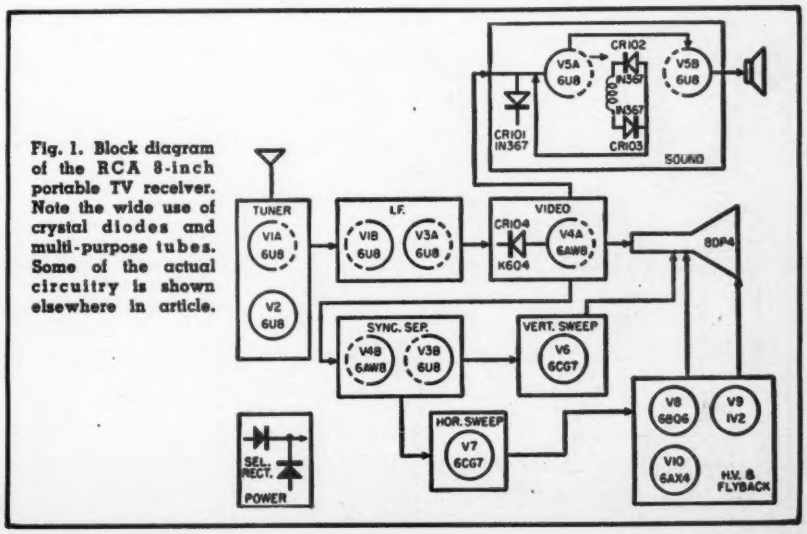


Fig. 1. Block diagram of the RCA 8-inch portable TV receiver. Note the wide use of crystal diodes and multi-purpose tubes. Some of the actual circuitry is shown elsewhere in article.

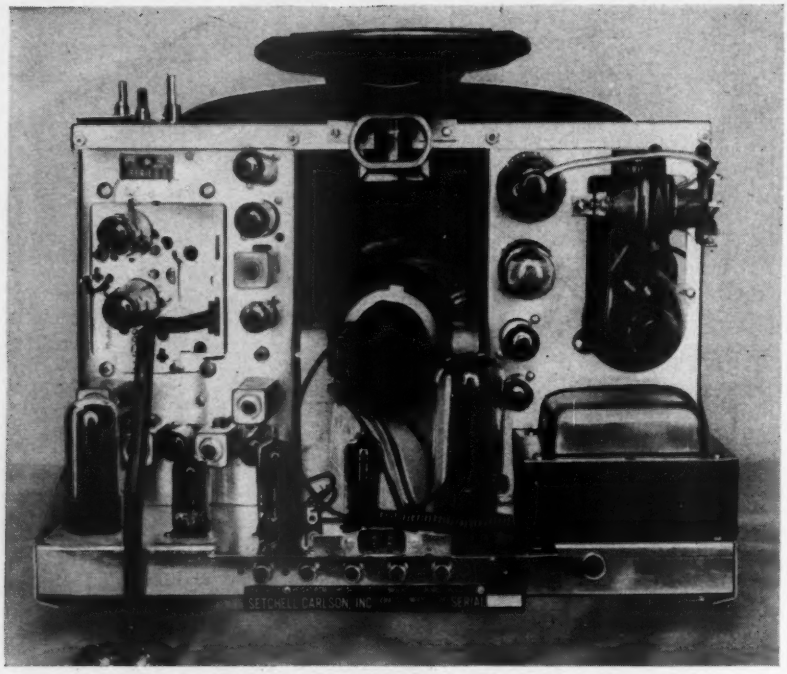


Fig. 2. Interior of the Setchell Carlson portable TV set shown in Fig. 7. Note the use of a power transformer and two-part chassis, horizontal and vertical.

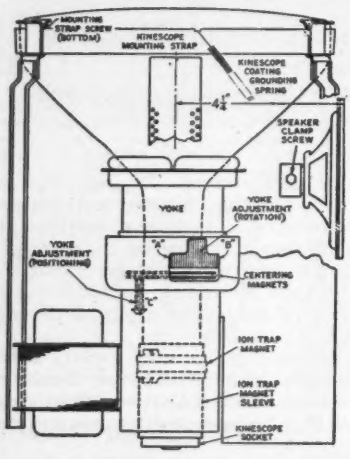
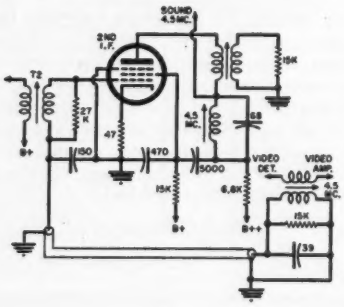


Fig. 3. Shown here are the various components on the neck of the 8-inch picture tube in the RCA portable set.

Fig. 4. Sound reflex circuit used in Emerson model 1030 portable. The 2nd i.f. also amplifies the sound carrier.



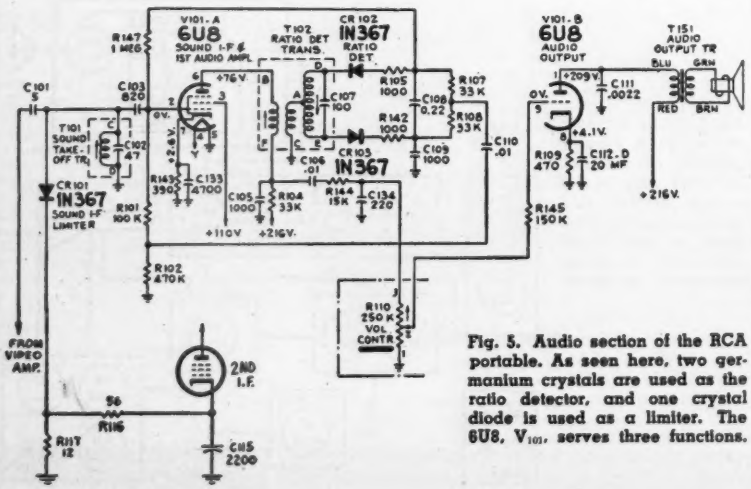


Fig. 5. Audio section of the RCA portable. As seen here, two germanium crystals are used as the ratio detector, and one crystal diode is used as a limiter. The 6U8, V_{101}, serves three functions.

formers and 5U4 rectifier tubes. Others, like the *G-E* model shown in Fig. 7, use a series heater, transformerless, voltage-doubler type power supply with tubes of the type having a controlled warm-up time. The *RCA* 8-inch receiver shown in Fig. 7 uses both a power transformer with 6.3-volt heater tubes and a selenium voltage doubler as "B+" source. It would seem from these examples that the design of the power supply section is largely a matter of available parts and relative cost, and these vary between manufacturers.

One design feature, common to all lightweight TV receivers, is the widespread use of multiple-purpose tubes. A typical example of this is in the *RCA* 8-PT-7030 series TV receivers which use only ten receiving tubes of which only the high-voltage rectifier, damper, and horizontal output tubes are single-function types. The block diagram of Fig. 1 shows how these ten tubes are arranged to perform the functions of 17 separate vacuum tubes. Note in particular the tuner and audio sections. A detailed discussion of the tuner circuit is presented in a later paragraph. The audio output tube is actually the triode section of the 6U8, which is sufficient in this application but not generally recommended as a power amplifier. The 6CG7 tubes used in the sweep sections are the 9-pin equivalents of the well-known 6SN7 dual triode.

It should be pointed out that in addition to the ten receiving tubes the receiver also uses four crystal diodes and two selenium rectifiers, the latter in the power supply. The crystal diodes are used in the conventional video detector application as well as in the unusual position as ratio detector and as clipper in the grid circuit of the audio limiter section.

The one almost universal feature among portable sets appears to be the use of vertical chassis. In some instances, as in the new *RCA* models, the chassis consists of two parts, one stacked vertically behind the other. Many receivers also make use of printed-wiring boards. In the *G-E* series "M" receivers, for example, the entire vertical chassis consists of printed-wiring boards with the components mounted towards the picture tube screen and the tubes accessible from the rear of the set. The printed-wiring assemblies are supported by the metal chassis which also holds the tube shields and other hardware.

Picture tubes used in the new portable receivers range from the conventional 17-inch size down to the new 8-inch rectangular types. While the 17- and 14-inch tubes usually use 70° deflection, most of the smaller ones, like the new 8-inch rectangular picture tube, use a 90° deflection angle and completely different deflection assemblies. Fig. 3 shows the adjustment points at the neck of the 8DP4 (the *RCA* 8-inch tube) and as can be seen here, this tube uses a short yoke, a centering ring assembly, and an ion

trap, all covered by a metal shield. Focusing is accomplished by the low-voltage electrostatic system well known from older tube types.

In external appearance the common feature of all portable equipment is, naturally, the carrying handle and the extreme compactness of the cabinet. The cabinets are most frequently made of metal, particularly aluminum for lightness. Indoor antennas are furnished optionally. Sometimes a short wire is connected to the power cord *via* a capacitor. Such line cord antennas are not too satisfactory.

A novel feature of the *RCA* 8-inch receiver is shown in Fig. 7. A small stand supports the set on a "U"-shaped bracket permitting it to be rotated and tilted for the optimum viewing angle.

The loudspeaker is often placed at the top of the cabinet, occasionally at the sides and, in the *Emerson* portable, the speaker and controls are accessible by opening a small panel at the top. This panel serves both as a dustcover and as a reflector for the sound, improving the acoustics of this set somewhat.

Circuit Features

Actually there are no radically new circuits in use in the new small-screen receivers. Only simplified circuits and novel component arrangements confront the technician and none of these is so different as to present any serious service problem. One of the novel arrangements is the sound reflex circuit used in the *Emerson* 1030 series models shown in Fig. 4. Here, the 4.5 mc. intercarrier sound signal is removed from the output of the video detector and, through a shielded wire, fed to the grid of the second i.f. amplifier, in series with the 41 mc. i.f. signal. At the plate of this stage there are two resonant circuits in series. One is tuned to a particular 41 mc. i.f. stagger frequency while the second network resonates at 4.5 mc. and serves as the output load for the sound carrier. This arrangement uses the 2nd i.f. amplifier for additional sound carrier amplification so that a substantial signal is presented to the sound limiter. The use of the second i.f. amplifier in this manner saves a tube and provides excellent intercarrier system performance.

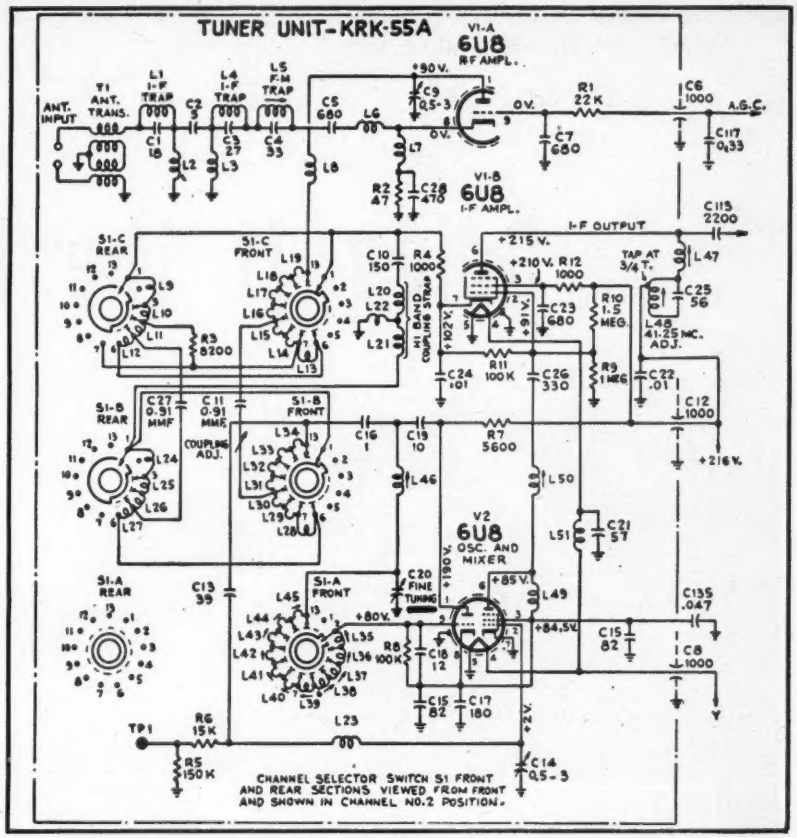


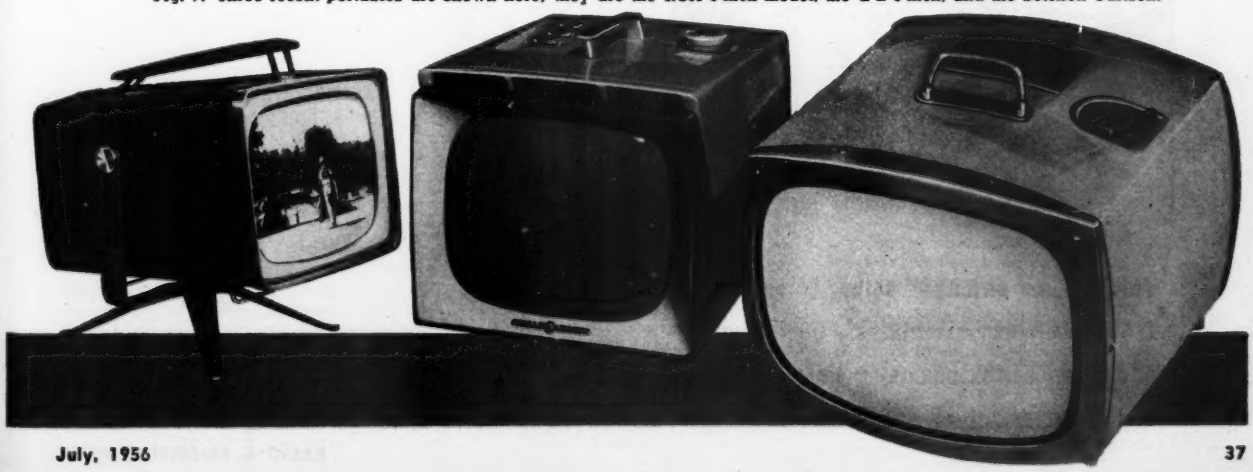
Fig. 6. Schematic diagram of the tuner used in the RCA portable showing how two 6U8's are used as r.f. amplifier, oscillator, mixer, and first i.f. amplifier.

Another circuit feature found in many portable TV receivers is the use of only two i.f. stages. This generally results in a compromise between bandwidth and gain which makes these sets a poor choice for a weak signal area. Of course, the smaller screen does not require as much picture detail and, therefore, some i.f. bandwidth reduction can be tolerated.

One method of saving tubes in the i.f. strip is shown in Fig. 6, the circuit of the tuner used in the *RCA* 8-PT-7030 receiver. Here the two tubes in the tuner actually contain four separate sections. One tube serves as an oscillator and mixer while the triode of the other tube is used as a grounded-grid r.f. amplifier. This leaves the fourth section, a pentode, for operation as the first i.f. amplifier. Bypassing and shielding as well as alignment of this tuner and i.f. amplifier combination are slightly more critical than for conventional circuitry but the performance of this arrangement is satisfactory.

(*Continued on page* 127)

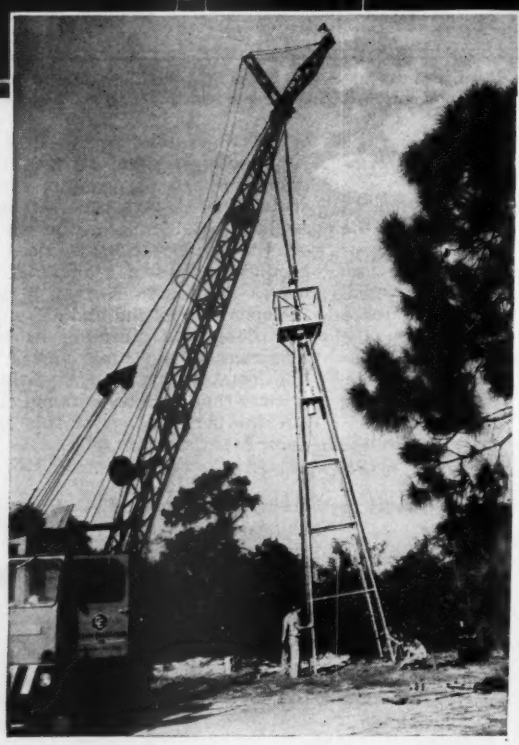
Fig. 7. Three recent portables are shown here; they are the RCA 8-inch model, the G-E 9-inch, and the Setchell Carlson.



By JOSEPH H. STEINMETZ, W4YI

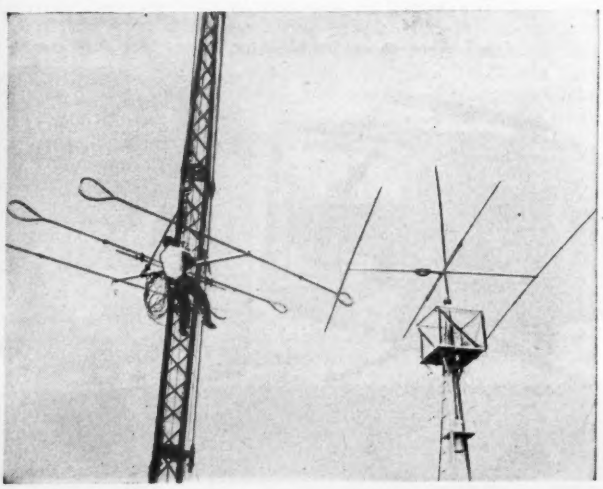
Doing It the Easy Way

Antenna location at Steinmetz home in Sarasota. At rear and above taller ladder is base of tower, 17 ft. high, which has concrete footings 3 ft. x 3 ft. x 4½ ft. deep. The 33-ft. Vesto steel tower was assembled on ground and is seen (right) with prop pitch motor already installed. The 20-m. beam is seen against sky on temporary support, as is 10-m. beam on short pipe on garage.

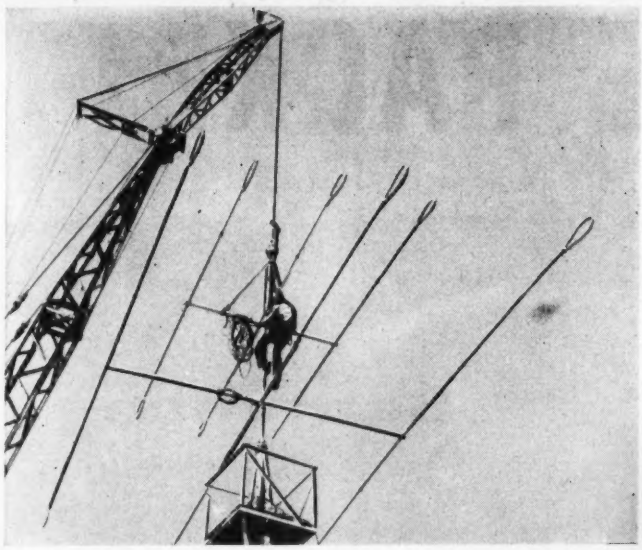


Concrete Engineering Company's crane is used to lift up the 33-foot section of the Vesto tower into its vertical position while helpers insert timbers under the feet to help "true up" the entire assembly.

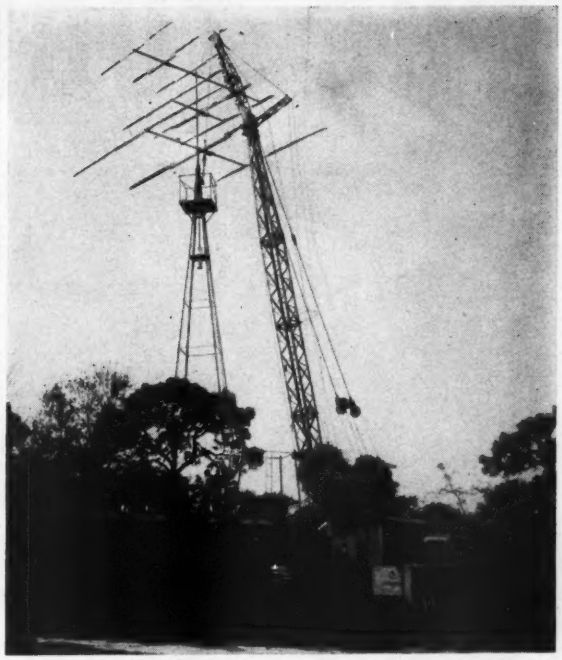
Concrete Engineering Company's engineer has placed the 20-m. beam on pipe and now has crane lift him, seated in a sling, and 15-m. beam, together with coaxial cable already connected so he can drop boom of beam slowly down over the pipe through 2-inch hole in boom. This proved to be a rather tricky operation but the whole business came off smoothly without a hitch.



This "dream antenna" setup, belonging to W4YI and W4TFP, features a 50-foot mast and three Telrex beams; a six-element 10 meter, 3-element 15 and 20 meter arrays.



The three-element 15-meter Telrex beam is bolted into place by engineer who works comfortably and safely in the crane-lifted sling.



Crane swings the tower from position on the right over toward its final position. The tower is being moved across the garage in this photo of the tower operation.

"ONCE a ham, always a ham"—and usually this includes your children as well. The antenna installation shown on these two pages and the mobile and ham shack stations shown later in the article are the proud possessions of the author and his son, Bill (W4TFP), an operator at the Duke University Electrical Engineering Department Station.

When we recently moved to our new home on Sarasota Bay, we decided that now was the time to build our "dream shack." Accordingly, we had a 50-foot tower erected which would get our three *Telrex* beams out in the clear and then fixed up an all-weather, year-around ham shack in a made-over storeroom in the back of the garage.

A specially designed desk supports the station's "Viking I" transmitter and NC-300 receiver. A five-position coaxial switch in the mahogany panelling of the shack allows instant switching from 75 to 40, 20, 15, or 10 meters. The coaxial cables are fed through the wall from the outside so that no wires clutter up the working area.

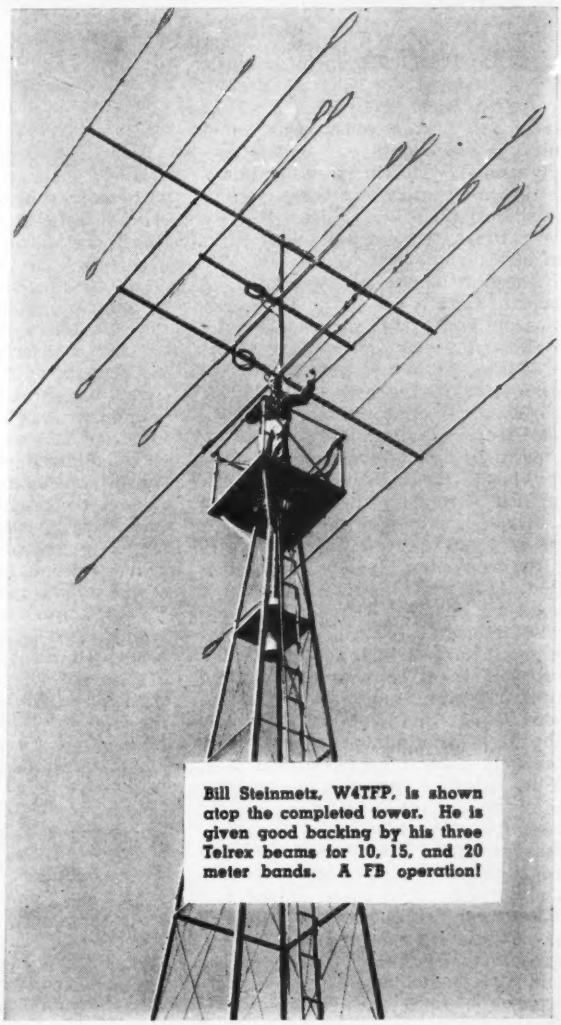
An indicating pointer, placed on Florida and moved by a selsyn behind a great circle map on the wall of the shack, shows us accurately where the beams are pointing. This selsyn is activated by a matching one geared to the rotating pipe in the tower just above the prop-pitch motor. The motor itself is enclosed in a heavy anodized aluminum tube which is bolted to the steel plate on which the motor rests. A "hat" of aluminum is fastened with its center around the mast. It overhangs the aluminum tube around the motor by 6 inches to make a water-tight seal and yet be rotatable. Heavy roofing compound seals all possible cracks.

The 75 and 40 meter antennas, the half-wave dipoles, are center-fed with 72-ohm balanced transmission twin-lead lines. When the lines get close to the ground, each feed into *B & W* balun coils and come out 72-ohm unbalanced coaxial lines, which then run into the shack and into the coaxial switch and thence to the pi network of the "Viking" final.

The shack itself is equipped with a *Philco* air conditioner for the hot summer days and an electric fan wall heater for those nippy winter mornings that we occasionally get—even in Florida!

Our mobile gear consists of an *Elmac* receiver and transmitter installed in our station wagon. For field days, Bill rigs up a *Chevrolet* generator connected to a gas-powered lawnmower to keep the battery charged during the 24-hour haul. This whole outfit is carried in a small trailer fastened to the car.

Needless to say, the author is completely "sold" on hamming as a hobby not only because it (*Continued on page* 120)



Bill Steinmetz, W4TFP, is shown atop the completed tower. He is given good backing by his three Telrex beams for 10, 15, and 20 meter bands. A FB operation!

THE TUBE RACKET

Boston Police Department identification photos of Joseph Lynch, convicted of tube rebranding.

Tube rebrander jailed and extent of racket revealed in Boston police case. Manufacturers now on the alert.

ON MARCH 26, 1956, in the municipal court of the City of Boston, Joseph Bernard Lynch, 35, of 82 Carver St., Boston, Mass., was found guilty on two counts: (1) with knowingly using fraudulent labels, and having in his possession counterfeiting equipment; (2) selling rebranded electronic tubes, being fully aware that the labels were fraudulent. He was sentenced to serve two years in the House of Correction.

Joseph Lynch was apprehended by the Boston Police Department working with the active cooperation of Gerald Hurley under the direction of Charles A. LaForge of the Security and Plant Protection Department of *General Electric Company,* Schenectady, N. Y. He had been counterfeiting tube labels and otherwise engaged in illegal practices of this nature for twenty years.

This conviction brings to light a practice that has been going on for a long time and has been costing tube manufacturers a great deal of money. As practiced by Lynch and others like him, the racket consists of obtaining faulty receiving tubes and returning them to the manufacturer for new tubes. The tubes thus acquired were then sold to service dealers at 70% off list price. Lynch would clean up the worn-out tubes, remove the old warranty code date and, in many cases, the tube manufacturer's label, and then place a new code date and label on the tube. This allowed the tube to be returned to the company for replacement under the warranty agreement. This practice is one of the counts under which Lynch was convicted.

As an indication of the exactness with which tube rebranders sometimes operate, refer to Figs. 1 through 5. In Fig. 1 are shown two tubes; one is a new tube, the other is a rebranded worn tube counterfeited by Lynch. Note how similar the labeling is on the tube bases. The one on the right has the counterfeit label.

Fig. 2 shows the equipment used by Lynch to rebrand tubes. Most of this equipment was obtained through unimpeachable sources when Lynch passed himself off as a salesman for legitimate electronic companies. The various trademarks and code designations used by some of the tube manufacturing companies are shown on engraver's proofs in Fig. 3 prior to being sent out to a rubber stamp engraver. Fig. 4 shows the completed rubber stamps used by Lynch for rebranding tubes. How this is done is shown in Fig. 5. The ink is first applied to a glass plate, rolled smooth, and then the rubber stamp is applied to it. Next, the unbranded tube base is rolled along the rubber stamp to pick up the counterfeit label.

The most important aspect of the whole racket is the fact that used or defective tubes were available to Lynch for his nefarious scheme. Lynch was able to obtain quantities of defective tubes by paying his various sources as little as 2c or 3c per tube. The sources themselves bear some of the responsibility for making these tubes available to Lynch since, if they had thought about it, they should have known that no legitimate use could be found for such tubes. Actually, some of the bad tubes that he received were within the warranty period. These did not require rebranding and obviously could be returned to the manufacturer for direct replacement. Here again, although this practice sounds legitimate, it was not. Actually, in the case of tubes that were still in warranty, these should have been destroyed since credit had already been obtained for them from the tube manufacturer. Why the manufacturer did not reclaim them himself when he extended the credit is very simple to explain.

Until the early part of 1955 most tube manufacturers would give credit or replace bad tubes that were within warranty without requiring the worn tubes to be returned to the plant. The district sales division would automatically approve such credits with the understanding that the distributor would destroy the bad tubes. Here the system fell apart as many such tubes were not destroyed but were obviously sold to individuals such as Joe Lynch.

Another method of handling in-warranty tubes, common until recently, was for the manufacturer to extend to wholesale tube buyers a discount of 5% in lieu of credit for "duds" on purchases of packaged tubes. In other words, the tube manufacturer assumed that about a 5% discount would cover the tube replacement cost and, therefore, extended the credit at

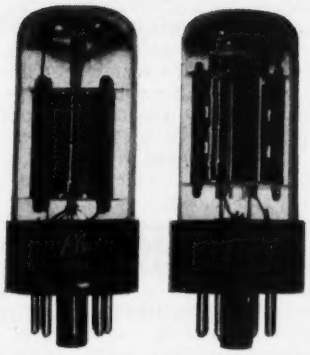


Fig. 1. One of these tubes is an old one that has been rebranded, the other is new. Note the thinner lines of the lettering of the tube on the right; it is the phony.

the time of purchase. When the defective tubes were found, it was left up to the tube wholesaler to dispose of them. This saved the wholesaler and the manufacturer the costs of handling defective tubes. Thus, many wholesalers instead of disposing of these "duds" often had them around the store in a convenient spot. This is how Lynch obtained his tubes. In this case Lynch would return them for credit to another distributor.

Tube manufacturers have been taking definite steps to run the rebranders out of business. To keep worn or defective tubes out of the hands of rebranders, *General Electric, Sylvania,* and many other tube manufacturers now use a tube-for-tube replacement plan. Under this plan, the wholesaler must send back to the tube manufacturer any defective tube covered by a warranty. The manufacturer then gives the wholesaler a new tube for it. The manufacturer then disposes of all "duds." This practice keeps such tubes out of the hands of possible counterfeiters and rebranders.

Besides this method of attack on the problem, some of the tube manufacturers are taking additional precautions. As indicated before, *G-E* is cooperating with local police authorities wherever its salesmen discover evidences of rebranding. *Sylvania Electric Co.* has offered a $1000 reward "for information leading to the arrest and conviction of an individual or company fraudulently branding tubes with the *Sylvania* name." The *Philco Corp.* buys up all old tubes for 5c each. These and other measures are designed to cut down on this racket.

The problem goes even deeper and tube users themselves can cooperate to beat the rebrander. For example, when a TV service technician replaces a tube in a TV or radio set, the replaced tube should either be left with the customer, or else be disposed of immediately by the technician. If the tube is still covered by the manufacturer's warranty, it should be returned to the parts distributor from whom it was bought or the equipment manufacturer's distributor and sent by him

(*Continued on page* 120)

Fig. 2. Equipment used by the convicted rebrander and some of the tubes found in his possession when he was caught recently.

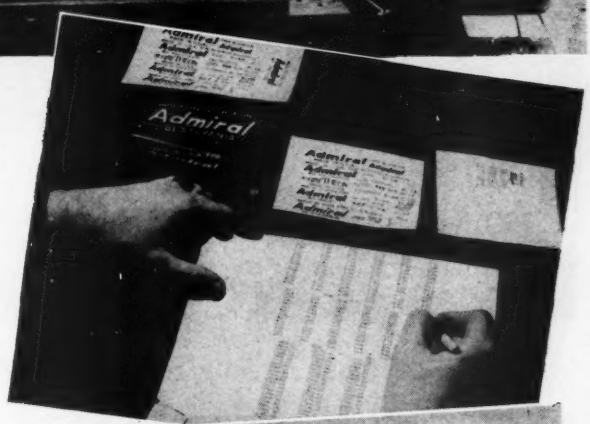


Fig. 3. These engraver's proofs contain the code numbers and trademarks of various tube manufacturers. Rubber stamps for rebranding tubes were made from these.

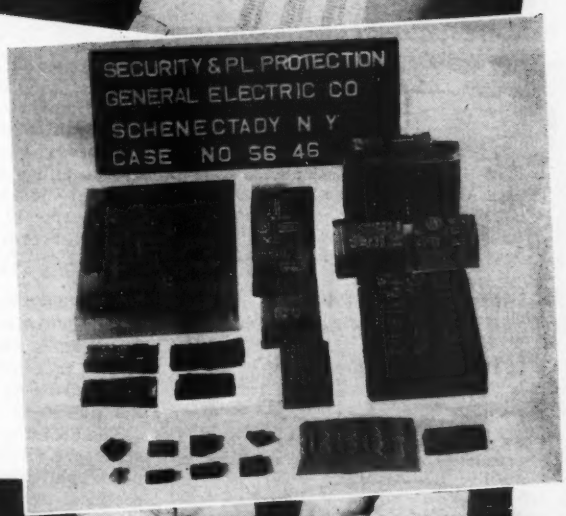
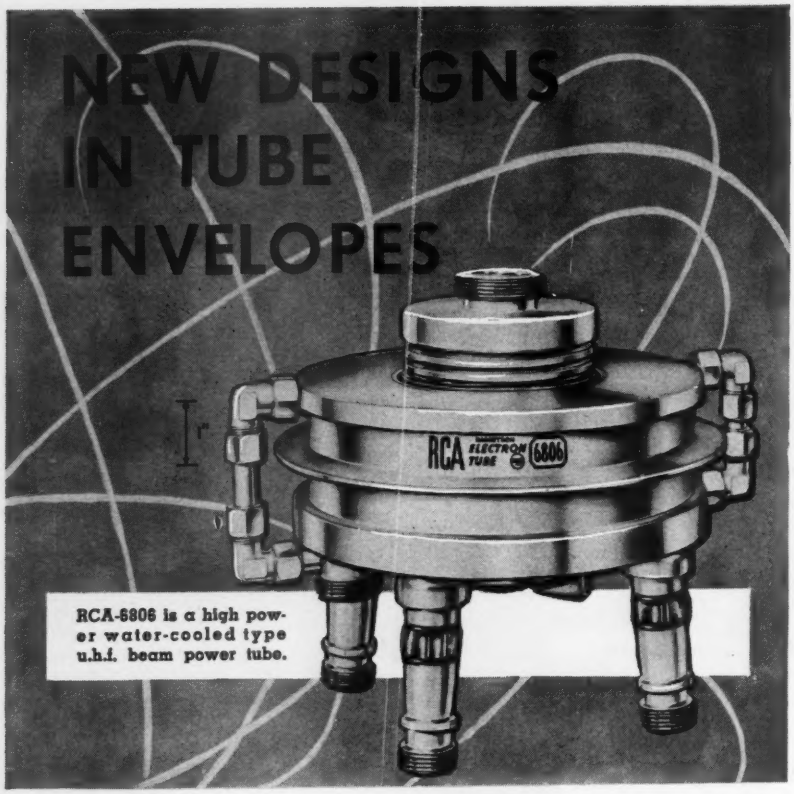


Fig. 4. Rubber stamps found in the possession of the tube rebrander. Note the wide variety of tube and equipment manufacturers represented. G-E was active in obtaining the evidence.

Fig. 5. How the counterfeit brand was put on a cleaned-up defective tube is shown.

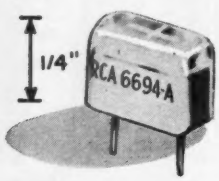
NEW DESIGNS IN TUBE ENVELOPES



RCA-6806 is a high power water-cooled type u.h.f. beam power tube.

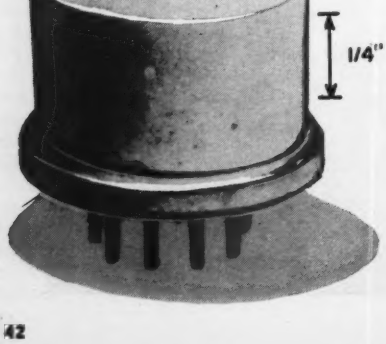
Some new tubes recently released by manufacturers are unusual in design, construction, and appearance.

G-E ceramic microminiature tube for u.h.f.-v.h.f. television tuners.



RCA-6694-A is a small cadmium-sulfide photoconductive cell.

Sylvania stacked type tube with a completely ceramic cap or envelope.



TO THOSE of us who have been accustomed to the ordinary run-of-the-mill variety of electron tubes, the photographs shown here may come as something of a surprise. Yet these tubes are just a few examples of some of the special types that have been released recently.

Type 6806 U.H.F. Beam Power Tube

The 6806 is a water-cooled power amplifier intended for operation at frequencies up to 1000 mc. In television transmitter service, the 6806 can deliver 28 kw. at 550 mc. or 17 kw. at 750 mc.

The 6806 features a coaxial electrode structure in which the centrally located plate is surrounded by a symmetrical array of unit electron-optical systems. Bypassing of the screen grid is provided by built-in capacitors. Ducts for water cooling are also built in.

Other features of the 6806 include low-inductance, large-area r.f. electrode terminals insulated from each other by low-loss ceramic bushings; relatively low output capacitance; and very low feedback capacitance.

Sylvania Stacked Tube

The stacked tube shown here employs a completely ceramic envelope mounted on a 9-pin miniature base. The shortness in envelope height is achieved mainly because of the unusual internal construction in which the various elements are arranged horizontally and are stacked one above the other. Small ceramic spacer washers are used to provide separation between the elements. The entire assembly is then placed within a ceramic cap or envelope which is then evacuated and sealed.

The ceramic envelope is much stronger than a glass envelope and the tube can be handled, dropped, and shipped without breakage. The envelope is also extremely rugged under widely fluctuating temperatures. The stacking procedure used in assembly of the elements also provides for high resistance to vibration and shock which might otherwise cause mechanical failure. In addition, the assembly lends itself to completely automatic production methods. Although the tube was designed for high-performance military applications, it will eventually become available for civilian use.

Type 6694-A Photoconductive Cell

The 6694-A is a very tiny, cadmium-sulfide photoconductive cell of the head-on type. It produces a signal output that is approximately proportional to the incident light intensity. Because of its very small size and high sensitivity, the cell is especially useful in those light applications where a single small photosensitive device is desired, in light-controlled relay applications, and in light meters for measuring the brightness of small luminous spots.

The 6694-A has a maximum seated length of 0.300 in., a maximum width of 0.375 in., a maximum depth of 0.220 in., and a minimum sensitive area of 0.020 in. by 0.018 in.

G-E Ceramic Microminiature Tube

The type 6BY4 is the first of a line of microminiature ceramic tubes released by *G-E* for a wide variety of applications. The 6BY4 is a high gain, low noise triode which is especially suitable for r.f. amplifier service in combined u.h.f.-v.h.f. television receiver tuners.

This tiny tube envelope is made up from small ceramic and metal layers arranged alternately. In the photograph one can readily see the two button contacts at the bottom of the tube to which the heater is connected. Then above the lower ceramic ring is the metal ring that makes connection to the cathode. Above this is another ceramic ring which is followed by a grid contact ring. Finally at the top of the upper ceramic ring is the plate contact button. A special socket is required to accommodate the 6BY4. The rigid and compact ceramic construction resists shock and vibration and withstands extremes in temperature. Automatic assembly is also facilitated with this construction. Information concerning the tube characteristics and circuitry is to be found in the March, 1956 issue of RADIO & TELEVISION NEWS (see "New Tube for U.H.F. TV," page 46). —30—

Transistorized Guitar Amplifier

By **PAUL PENFIELD, JR.**

Fig. 1. The compact amplifier shown connected to the pickup mike on guitar. A handle or strap on cabinet would permit amplifier to be carried easily.

Construction details on a portable, easy-to-build unit which uses two power transistors and is self-contained.

ONE of the pleasant duties electronic equipment has to perform is that of amplifying music. Depending on the reader's viewpoint, that may be anything from classical music down to rock 'n roll. The general dissemination of music to the public had to wait for electronics. Nowadays every symphony orchestra in the country is available to anyone for the price of a record or the tuning of a radio dial. Before the electronic revolution of the twentieth century, only the privileged few could afford to attend concerts—today anyone can have music wherever he goes.

Many musical instruments depend entirely on electronics for their existence: electric organs, theremins, and electronic carillons, to mention three. Other instruments often employ electronic amplification of one sort or another, either to play to a large audience or because the natural volume output from these instruments is low. The most notable instrument which is often helped out by electronics is the guitar. Guitar amplifiers have been used for some time to allow a guitarist to play his low-power instrument before large audiences.

Because it is such a versatile instrument, the guitar is very popular. Enough citizens play the guitar so that the subject of guitar amplifiers is of wide interest. Normally, such amplifiers operate from the 117 volt a.c. line and employ vacuum tubes. This sometimes inconveniences guitarists who wish to operate from a field or outdoor arena, or who may wish to move about with their instruments, such as in a parade. Recently available high-power transistors make a high-power transistorized amplifier for guitars practical. A suitable amplifier, which the reader can easily make for himself, is described in this article. The space and weight contributed by the amplifier and batteries is small compared to normal eight-inch or ten-inch loudspeakers, so the size of the amplifier cabinet is determined entirely by the size speaker used. Since heat is no problem, the entire cabinet may be sealed or not at the builder's discretion.

The following are the general requirements that were set down for this guitar amplifier:

(1) Frequency response: not critical —50-3000 cycles-per-second is adequate, since the lowest tone played (E below C below middle C) is about 82 cycles, and the highest (2 C's above middle C) about 1000 cycles.

(2) Distortion: not critical, since the device is only put to one use. Low-order harmonics, if kept within 5% or so, do not seem to detract materially from the sound.

(3) Noise: as low as possible—this dictated the use of a low-noise transistor in the first stage.

(4) Adequate amplification: to permit the guitarist to have as much gain as he desires, or as little. This gives the performer more versatility.

(5) Adequate power output: the unit was designed around a pair of high-power transistors.

(6) Low standby power: this dictated the use of class B operation.

(7) Lightweight, small-size: limited only by the size speaker used.

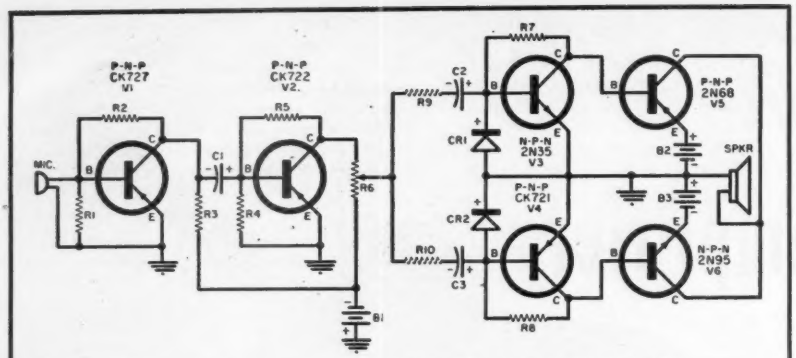
(8) Good-looking: this "extra" pleased the author's sense of beauty and accomplishment, however, the reader may or may not wish to dress up his unit. Extra work in this regard may or may not be necessary, depending on whether the reader builds his own cabinet or not.

The Circuit

The completed guitar amplifier system, shown in Fig. 1, and again in Fig. 3 uses a pair of power transistors in the output stage. Fig. 2, the circuit diagram, shows the *Sylvania* 2N68 and 2N95 in the output circuit. These transistors are now available generally through jobbers. The other four transistors are readily obtained.

The microphone used by the author is an *Amperite* "Kontak Mike," model SKH, a high-impedance magnetic microphone specially made to pick up vibrations only from the surface with which it is in contact and not from the surrounding air. The mike puts out about the same volume level as a variable reluctance cartridge—indeed *Amperite* recommends the use of the *G-E* variable reluctance preamp, or equivalent, when connecting the mike to an ordinary amplifier.

This fact, incidentally, points up the conclusion the author reached by experiment: proper operation of the mike requires that bass boost be incorporated in the amplifier. The sound of the mike through an unequalized amplifier is quite tinny and deficient in bass. However, by properly designing a *transistor* amplifier for use with the mike, we can forget about equalization. This is simply because normal transistor amplifiers have low input impedances, which means current may flow through the mike. When it is connected to a high-impedance grid circuit, the *voltage* output waveform is amplified. With a transistor amplifier, however, the *current* output waveform is amplified. Since the mag-



R_1, R_4—4700 ohm, ½ w. res.
R_2, R_5—27,000 ohm, ½ w. res.
R_3—2700 ohm, ½ w. res.
R_6—2500 ohm volume control (audio taper)
R_7, R_8—150,000 ohm, ½ w. res.
R_9, R_{10}—See text
C_1, C_2, C_3—10 μfd., 12 v. elec. capacitor (Observe polarity on diagram. See text)
Mic.—Contact microphone (Amperite SKH)
B_1, B_2, B_3—6-volt miniature battery (RCA VSO68, Burgess Z4, or Eveready 724)

CR_1, CR_2—1N34 or 1N34A diode
V_1—"p-n-p" junction transistor (Raytheon CK727)
V_2—"p-n-p" junction transistor (Raytheon CK722)
V_3—"n-p-n" junction transistor (Sylvania 2N35)
V_4—"p-n-p" junction transistor (Raytheon CK721)
V_5—Power transistor (Sylvania 2N68)
V_6—Power transistor (Sylvania 2N95)

Fig. 2. Schematic of amplifier. If more gain is required (although unlikely) V_2 may be changed to a CK721 or CK725 without other modifications in circuit.

netic microphone is mainly inductive rather than resistive, and furthermore, since the load impedance into which the microphone works is so very low, approximate equalization occurs. The same thing, of course, is true with a variable reluctance cartridge—if operated into a very low impedance circuit, no equalization is required, to a first approximation.

Because no equalization is required, the amplifier is made just that much simpler. The first two stages (see Fig. 2) are standard. The 10 μfd. capacitor between them was used because it was on hand—anything upwards of 3 or 4 microfarads would do. A separate battery is used to power these first two stages to prevent motorboating, which is often a serious problem in multistage transistor amplifiers. The first stage uses a low-noise CK727 transistor; the second stage uses an inexpensive CK722.

The last two stages are not standard at all. The final stage, consisting of a 2N68 and a 2N95, is operated class B complementary. Complementary operation is the simplified form of push-pull possible with transistors, but not with vacuum tubes. The two transistors are of opposite types—one *p-n-p* and one *n-p-n*. One truly "pushes" while the other one "pulls" and yet the output is single-ended, and so no output transformer is required. Since there is no "opposite type" of vacuum tube, no corresponding circuit exists, and normal class B tube amplifiers have double-ended output, and must use an output transformer. In addition, the output impedance of the 2N68-2N95 stage (the two transistors are made with "equal but opposite" characteristics, and are therefore called complements of each other) is quite low, so that the eight-ohm speaker serves directly as the load. (For a discussion of this and other types of power transistor operation, refer to the author's article "Power Transistors," which appeared in the February issue of RADIO & TELEVISION NEWS.)

The output stage is driven by another pair of complementary transistors operating push-pull—this time a 2N35 and a CK721. The entire collector current of each driver transistor flows through the base of the power stage transistor of the opposite type, thus there are no "coupling losses" between driver and output stages. In addition, the bias state of the last stage is determined by the bias conditions on the driver transistors which, in turn, are determined by the size of R_7 and R_8. The almost complete absence of anything but transistors in the last two stages indicates that complementary amplifiers have a definite economic advantage over conventional transistor amplifiers!

The two diodes are arranged oppositely directed to the emitter-to-base junctions within the driver transistors, in order to prevent the base voltage of each transistor from changing when a signal is applied to the stage. If these were not in the circuit, the rectifying junction between emitter and base of each transistor and the coupling capacitor would act like a small rectifier-filter combination, building up a voltage on each base which would greatly interfere with the normal amplifier biases. This voltage would vary from time to time depending on the input amplitude, tending to keep each transistor close to cut-off.

Again, the two coupling capacitors C_2 and C_3 happen to be 10 μfd. only because the author had a few on hand. Anything upwards of 3 or 4 microfarads will do. If any value lower than this is used, low-frequency response will start to suffer.

The design of the final stage amplifier is intentionally conservative, that is, under normal operation, there is not a chance in the world that the transistors will become overheated. The reader thus can be assured that his investment of ten dollars or more for the two final-stage transistors will not "go up in smoke" because the transistors were operated too close to their maximum ratings. Although this fact means that less power output is obtained, still the output is satisfactory for most applications and, in fact, is more limited by the speaker and its enclosure than by the final stage design.

Construction

Since the transistors and associated components don't require much space, the construction of the amplifier is more or less that of building a cabinet for the speaker used. Details on this of course depend on the type and size speaker used. The author's cabinet (shown "exploded" in Fig. 3) was made out of scraps of cheap white pine and plywood to fit an existing eight-inch speaker. It was made barely large enough to enclose the speaker, as a result the acoustics of the instrument are not as good as if a larger volume of air were backing up the speaker. The reader may want to use a commercially-built speaker enclosure, in which case the remarks made here about cabinet construction won't apply.

The author's home-built enclosure was tailor-made for the application—a simple six-sided rectangular box, made to fit the speaker snugly. The speaker hole was not cut perfectly round, but this fact was hidden by covering the entire front panel with speaker cloth, instead of only the part behind the hole. The side panels and the rear board were finished by applying *Meyercord* "plastic veneer." The effects obtained from the "Striped Walnut" are quite striking. Of course the reader may use whatever "beauty treatment" strikes his fancy—paint, varnish, stain, or plastic veneer over unfinished wood or other types of finishes if desired.

The placement of the electronic parts is not at all critical. It is recommended that the jack for the mike be mounted close to the bottom of the case, to prevent a sudden tug on the cord from upsetting the amplifier. The volume control and the "on-off" switch may be mounted anywhere that is convenient.

The author mounted his batteries by chiseling out a depression of the right size in one of the side panels, and then forcing the batteries into it, and holding them in with a rubber band held down by thumbtacks. The reader may prefer to use a metal clip of some sort to hold down the batteries; however, the rubber band is simple and (unless it breaks under the tension) makes a very effective holder.

The power transistors are bolted directly to the speaker frame. This is possible because the two collectors of the final stage are connected together. (The case of each transistor is connected internally to the collector to

provide proper heat sink operation.) The speaker frame thus acts as the required heat sink. The leads were cut to a quarter of an inch and a standard subminiature tube socket was used. Since the transistor is immobile, of course, the socket must be soldered to three flexible leads.

The rest of the transistors were also mounted by plugging them into standard subminiature tube sockets. For the three *Raytheon* transistors, pins 1, 3, and 5 were used and for the *Sylvania* 2N35 transistor, as for the two power transistors, pins 1, 4, and 5 were used. The subminiature tube sockets were then mounted by bending the two unused terminals to one side, and soldering them into one lug on a soldering strip. The reader may, of course, use whatever system he desires for mounting the sockets, or if he wants may solder the transistors directly in place in the circuit.

The input stage should be mounted relatively close to the input jack, although the absence of power-line a.c. eliminates the hum problem completely. Still there is the possibility of undesirable feedback occurring from output to input if the input leads "wander about" too much.

Other than these few tips, the construction of this amplifier should not prove very difficult for anyone with transistor wiring experience. Not more than one or two evenings should have to be spent on the electronic construction, and probably not much (depending on the reader's carpentry skill) on the cabinet. The device is thus a "one-week project" for anyone wanting a good portable guitar amplifier.

Performance

The instruction sheet sent out with the *Amperite* microphone suggests a number of possible way to attach the mike to guitars, violins, harmonicas, pianos, accordians, etc. Two ways were tried by the author. In the first, the mike was forced under the strings just below the bridge (this is not possible on all guitars), and in the second the mike was held with paper clips to the sounding board. If neither of these ways works on the reader's guitar, he may be able to use *Scotch* tape, rubber bands, etc., to advantage. A little experimentation is necessary to determine the proper placement.

After the instrument is made and the mike fastened to the guitar, the device may sound distorted. In fact, the chances are that the amplifier *will* sound distorted, and for a very good reason. Present quality control on transistors is such that it is impossible to obtain two matched units simply by buying two transistors. This is especially true of power transistors. The 2N68 and the 2N95 the reader buys may have quite different gains, unless the reader is willing to write the manufacturer direct and pay extra for matched pairs. Since the gain of the two sides will, in general, be quite different, considerable second-order distortion is generated. If the reader has access to an oscilloscope and signal generator, a sine wave may be injected into the amplifier and the output waveform viewed. In general, there will be a fair amount of distortion. Fortunately, however, it is rather easy to get rid of the trouble. Resistors R_9 and R_{10} are inserted for just this purpose.

The effect of these resistors (generally one of them will be zero, and the other one anywhere up to a couple of thousand ohms) is to cut down the signal feeding the side with the higher gain, thus equalizing the output from both sides. Finding the proper value for this resistor is not difficult: if an oscilloscope and signal generator are at hand, merely find the size resistor in either of the two leads which gives the best-looking output waveform. If no scope is handy, a rough job may be done by ear—merely find the value which gives the most pleasant output sound. The reason the adjustment is not critical is that guitar sound waves generally have a high content of second and third harmonics in them anyway, and so the addition of a few percent more second order distortion is insignificant. Care should be taken in construction to make sure that this adjustment can be made easily after the unit is built. For this reason, the leads to the bases of the driver transistors, V_3 and V_4, should not be buried where they are hard to get at.

Once this adjustment is made, the quality of the sound coming from the amplifier will probably be limited only by the speaker and enclosure. For a really portable system, the case will be quite small, with a resulting loss of fidelity. A compromise between small size and good quality must be made by the builder. The author's eight-inch speaker and small cabinet may seem too large for some readers or it may seem too small for others.

In practice, the noise level is audible if the volume is turned up all the way. However, when this is done, the device has phenomenal sensitivity, picking up and amplifying even the tiniest scratch on the guitar case. At normal playing volumes, noise is no problem.

Guitarists not used to playing with a mike will be surprised at the inadvertent scratching, rubbing, etc., which they normally do in the course of playing, and which will be audible through the amplifier. This, of course, is one of the drawbacks of this type of electric guitar, which amplifies vibrations of the sounding board. A little practice is necessary to get the best music out of the system as a whole.

All through the article, the author has tried to suggest variations which can be made on the amplifier, to improve it from the user's viewpoint. A few other improvements suggest themselves: for example, a handle or carrying strap would be desirable. An arrangement for carrying the amplifier on the person may be useful in parades, or other walking activities. The amplifier could be built in a cardboard box to reduce weight or, alternatively, a metal cabinet could be used to make the unit more rugged.

The reader may be interested in using the amplifier for other purposes than just guitar amplification. Other musical instruments, of course, can be amplified with this device, for example, xylophones, ukeleles, cellos, certain drums, mandolins, pianos, banjos, etc. Or else, the device could be used with the contact microphone as a vibration tester—completely portable and ready for use "in the field."

If desired, an output jack may be added to allow the amplifier to feed a public address system, or to allow the output to be viewed on a scope, or fed into a tape recorder. The possibilities of adapting this amplifier to special purposes is, of course, practically unlimited.

But for a simple, all-around portable guitar amplifier, this will do the trick. It is lightweight (limited mainly by the cabinet), small, easy to construct, easy to operate, and adequate-sounding. This is about all that can be asked of a transistorized guitar amplifier. -30-

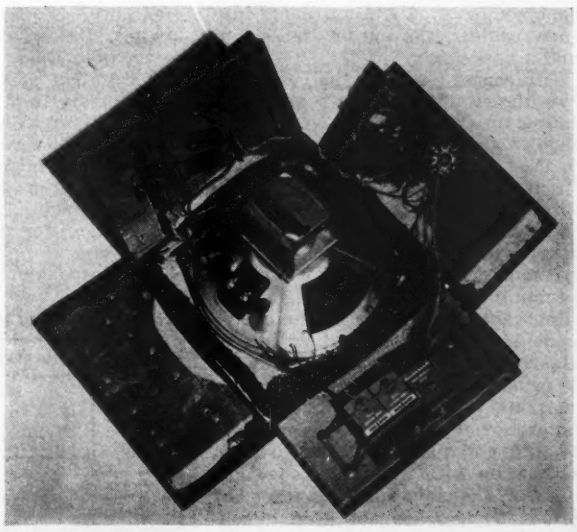
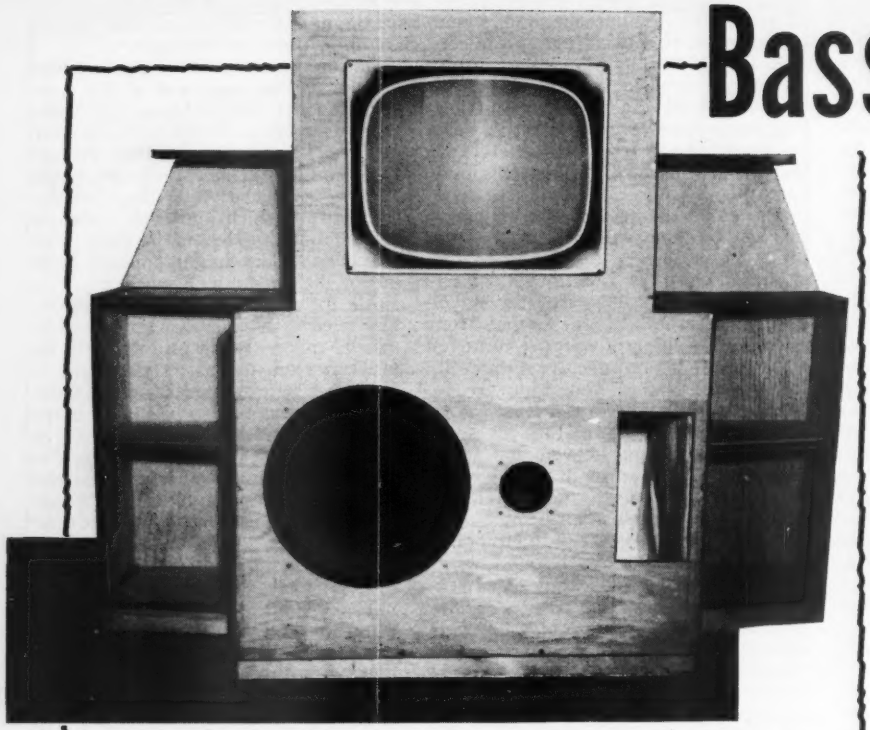


Fig. 3. Interior view of the amplifier with the sides "exploded." Note the two power transistors (one almost hidden) bolted to the loudspeaker frame.

Bass Reflex Design or Accident



Over-all view of the author's home "entertainment center" which includes a TV set and bookshelves in addition to the amplifier and speaker enclosure. A grille cloth covers front of enclosure and entire unit was painted to match living room decor.

By
ROBERT C. SANFORD
Asst. Editor, Bell Laboratories Record

Practical design data on such enclosures is rare—the author offers workable information for various sizes of speakers.

WHETHER you are a hi-fi addict or just happen to like good clean bass reproduction, the least expensive and certainly the simplest type of speaker enclosure for home construction is a bass-reflex or "phase-inverter" type; all it amounts to is a box with a hole in it. Having a fairly good 15-inch speaker on hand, and being in the process of rebuilding a radio-TV-phono combination and putting it into a new cabinet, the author decided to build a bass-reflex.

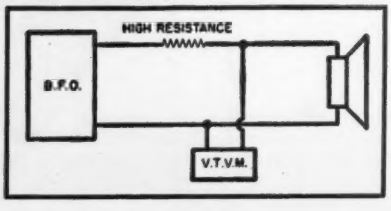
With access to one of the best technical libraries, it was just a matter of looking up the details as to the size, shape, and location of the port, and the size and shape of the enclosure. This beautiful day-dream was quickly shattered because, instead, some authorities treat a bass-reflex as a Helmholtz resonator, some as a special type of resonator, and others, not wishing to commit themselves, simply ignore it!

Reputable authorities in the acoustic field as well as several writers of magazine articles disagree widely on the principles involved, the descriptive equations, the equivalent diagrams, and even the symbols. Nowhere could the author find a simple down-to-earth explanation with a workable equation. Some of the equations advanced by various writers are not even dimensionally correct; others, while dimensionally correct, have no logical basis. Most important, they don't work. After pages of "design" information, each explanation ends up with, "for best performance, tune the port." Why bother? You might as well build a box, cut a hole in it, measure the response, and try again until it's right.

This is no way to build a speaker enclosure. So, with absolutely no qualms, the author worked out his own explanation, equivalent diagram, and equation using his own symbols. Undoubtedly they will not agree with those of certain authorities but they are bound to agree with some of the others! The important thing is, the equation works. For those who just want the facts, Table 1 gives all the information; for those who want more —read on.

A loudspeaker, with or without a baffle, is a mechanism that converts electrical energy into mechanical motion, which in turn is converted into acoustic energy. A speaker has quite a low impedance; coupled to an output amplifier tube through a matching transformer, it sees the high plate impedance of the tube. Thus, a speaker is fed from a high-impedance source and is essentially a constant-current device. To measure the impedance, feed the speaker from an audio signal generator through a high series resistance, Fig. 1. With a constant current through it, the voltage measured across the speaker will go up or down with the impedance. Fig. 2 was plotted for the author's speaker, using a v.t.v.m. and a b.f.o. output of 10 volts through 200 ohms.

Fig. 1. Measuring loudspeaker resonance.



The electrical resistance, inductance, and capacitance are of little importance at low frequencies; the mass of the cone, voice coil, and their supports and the compliance of the supports determine the resonant frequency. One other quantity is viscous friction set up by the cone moving through the air. It is low at low frequencies, increasing with frequency until the diaphragm circumference approximates the wavelength, and then stays nearly constant.

The current is the same throughout a series electric circuit and inductance is the controlling factor because it tends to keep the current constant. Current through a capacitance can be changed at will, so capacitance offers

a "compliance" to current. In a series mechanical circuit, mass offers resistance to change in position or motion while a restoring element or spring supplies compliance. Mass, then, is analogous to inductance and compliance is analogous to capacitance. Viscous friction is the mechanical analogue of resistance.

Fig. 3 shows how these quantities are coupled to the electric circuit. The voice coil is part of the electric circuit and is *mechanically* coupled to the cone and its supports. *There is no electromagnetic coupling* as is shown in some equivalent diagrams. At mechanical resonance, the cone excursions become quite large, indicating minimum mechanical impedance, yet at the same time the measured electrical impedance becomes a maximum. Why the discrepancy? The answer is the voice coil moving in a magnetic field. As it moves, it induces a counter-e.m.f. in itself, reducing the effective applied voltage. This is equivalent to raising the voice-coil impedance. Minimum mechanical impedance produces maximum voice-coil motion and therefore maximum electrical impedance. When mechanical impedances are translated into their electrical equivalent, they are inverted and result in a parallel electrical circuit, Fig. 4. The effect of mass is now analogous to that of capacitance while compliance acts as inductance.

Another way of looking at it is: with a constant current, a higher impedance produces a higher voltage and therefore more power is used. More electric power means more movement of the cone. In either case, higher impedance goes with more cone movement so the impedance is a measure of the sound pressure output. Whether or not a given sound pressure at a given frequency is audible is determined by your ear. For example, the sound pressures at 30 and 120 cycles represented by Fig. 2 are about the same, yet the 30-cycle note sounds much weaker. The idea of a bass-reflex is to damp the speaker resonant peak and boost the frequencies below the peak.

If the speaker is placed in a completely enclosed box, the air inside the box will act as a spring, tending to reduce the cone movement. This is shown in Fig. 3 as an additional series compliance. Translated into the electrical circuit of Fig. 4, it acts as another inductance in parallel, raising the amplitude and frequency of resonance. See Fig. 5.

If we now cut a hole or port in the box, the springiness of the enclosed air will be reduced. The mass of air in the port acts as a virtual diaphragm; this, together with the compliance of the enclosure, forms a second tuned circuit. The enclosure compliance is common to both the speaker and port tuned circuits. This time, however, the compliance instead of the mass is the driving element. There is a time lag between motion of the air near the speaker and of the air mass in the port because of the compliance, or "squeezeability," of the enclosed air. At the port resonant frequency the time lag is that of a half wave and the virtual diaphragm moves in the same direction as the speaker cone. This "phase inversion" results in sound from the port being in-phase with that from the speaker while at the same time the speaker is heavily damped to reduce its output.

The effect of the port is equivalent to adding mass and viscous friction in parallel with C in Fig. 3 or inductance and resistance in series with $1/C$ in Fig. 4. At the frequency where the port and compliance resonate, the impedance across the circuit in Fig. 4 will be very low. If this is the frequency at which the speaker resonates, the low impedance of the series resonant circuit will shunt that of the speaker, holding down its normal resonant impedance rise.

The resulting curve, Fig. 5, shows two smaller peaks, one above and one below the speaker resonant frequency. The frequency of the dip between the two peaks is that of the enclosure and port; for a given volume and port area, this frequency will be the same *irrespective of the speaker used.* The speaker does, however, affect the amplitude at the dip and the amplitude and frequency of the two peaks. Above resonance the speaker-tuned circuit is capacitive, Fig. 4, while the port-tuned circuit is inductive. As the frequency is lowered, the reactances approach each other in value and eventually become equal; this produces the upper peak. Below this, the shunting effect of the port-tuned circuit predominates and causes the dip. At still lower frequencies, the reactances of the two tuned circuits are reversed, producing the lower peak. It is this lower peak that extends the low-frequency range. The small peak at the bottom of the dip is the result of placing the speaker and port as far apart as possible. It is a form of overcoupling of the tuned circuits.

Apparently, a complete mathematical description of the impedance of a speaker system involves Bessel functions of the first and second kind. However, over the frequency range to be considered, the impedance approximates that of a simple resonant circuit. No matter how it is produced, resonance always occurs when two elements provide equal amounts of opposing types of reactances. For a

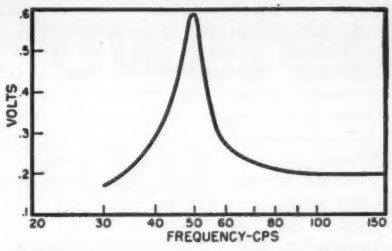


Fig. 2. Voltage measured across voice coil when the speaker is fed as shown in Fig. 1.

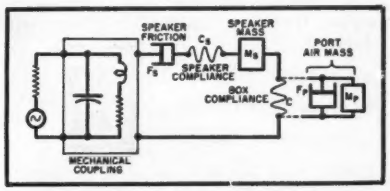


Fig. 3. Coupling of the mechanical elements.

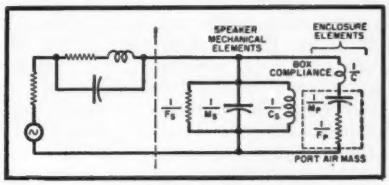


Fig. 4. The equivalent electrical circuit.

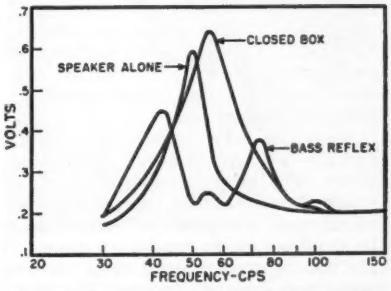


Fig. 5. Composite curves of the system.

Table 1. Basic formulas for determining cabinet dimensions and sizes of port areas.

$F_s = A\rho c$ above $2\pi R/\lambda \approx 1$

$X_{ms} = A\, d\rho c\omega$

$X_{cs} = A^2 \rho\, c^2/V\omega$

All values in mechanical ohms where A is the port area and R is the equivalent radius $\sqrt{A/\pi}$, both in square meters. ρ is the air density in kilograms-per-cubic meter; c is the velocity of sound in meters-per-second; V is the enclosure volume in cubic meters; ω is $2\pi f$; and d is the thickness of the enclosure wall at the port in meters.

$$f = \frac{c}{2\pi}\sqrt{\frac{A}{d'V}} = 54.7\sqrt{\frac{A}{V(d + 1.13\sqrt{A})}}$$

$$V = \frac{2992A}{f^2(d + 1.13\sqrt{A})}$$

and:

$$A = \frac{.64V^2f^4}{k^4} + \frac{f^2Vd}{k^2} \pm \frac{f^3V}{2k^4}\sqrt{1.63V^2f^2 + 5.12k^2Vd}$$

where: f is in cycles-per-second; k = 54.7, and all dimensions are in meters

speaker system, the reactances can be expressed in three different units: electrical ohms, mechanical ohms, or acoustic ohms. The author chose to work with mechanical ohms because dimensionally they are easiest to handle.

Using dimensional analysis and common sense, the author came up with values for the viscous friction, mass reactance, and springiness (reciprocal of compliance) reactance in mechanical ohms that agreed with most of the texts. Setting the reactances equal, the equation for resonance was derived:

$$f = (c/2\pi) \sqrt{A/dV}$$

or, in a more familiar form:

$$f = 1/(2\pi \sqrt{Ac^2/dV})$$

where A is the port area, V is the enclosure volume, d is the thickness of the enclosure wall at the port, and c is the velocity of sound.

But, this is the equation most authorities give for a Helmholtz resonator! Such a resonator is usually spherical so that no two surfaces are parallel, the inside surfaces are smooth, and the largest dimension of the port is considerably less than the smallest dimension of the enclosure. The dimension d usually refers to the length of a small tube extending from the resonator and forming the port. All these criteria are disregarded in a conventional bass-reflex, so it cannot be a typical Helmholtz resonator. Besides, the equation doesn't work for practical enclosures.

What to do? Further reading brought to light the fact that a resonant column such as an open-ended organ pipe is slightly shorter than the sound wave produced. The length must be modified by an "end correction." If the pipe is open on both ends, the end correction must be doubled. The value of the end correction varies according to how the pipe is terminated, but for a pipe ending in an infinite baffle (flanged pipe) it is considered by most authorities to be 0.85 times the radius; for both ends, this becomes 1.7 times the radius. Since the wall thickness of a bass-reflex enclosure corresponds to the length of the exit tube of a Helmholtz resonator, it was assumed that a "finagle factor" was needed.

The thickness now becomes $d' = d + 1.7R$ where R is the equivalent radius of the port area, or $\sqrt{A/\pi}$. Unfortunately, the calculated frequency does not agree with that measured for an actual enclosure. Some port areas were tried as were the values of areas and resulting frequencies from published articles. Something was still wrong with the equation.

Considerable thought went into the problem and it was finally decided that the end correction was too small. The value for a pipe presupposes that the radius will be small in comparison with the length. If the pipe is shortened almost to nothing, certainly to less than the radius, the end correction becomes the major factor. What would be the limiting value? Assuming the thickness to be negligible, it seemed logical that the maximum value of the end correction should be 1.0, or equal to the radius. Since both sides of the port have to be considered, the "finagle factor" should be 2.0. The enclosure that resulted is shown in the photograph, page 46. The port area is 50 square inches; checking back from the measured curve, this gives a "finagle factor" of 1.96, approximating the value of 2.0, well within the accuracy of the measuring equipment. The final equation is:

$$f = 54.7 \sqrt{A/V(d + 1.13\sqrt{A})}$$

with all dimensions in meters.

Since the cabinet had already been constructed, finding the proper port area was next. As can be seen from the equation, the lower the frequency of resonance, the larger the volume or the smaller the port. The port size affects the "Q" of the port-tuned circuit but not in any easily determined way. The "Q," in turn, affects the amplitude at the dip and the amplitude and frequency of the peaks. A generally accepted rule is that the port area should be nearly the same as that of the speaker. This is OK for small speakers but the enclosure gets unwieldy for large speakers because as the port area goes up, the enclosure volume must also go up to maintain the same resonant frequency. A good rule to follow is to make the port area A, in square inches, equal to the speaker resonant frequency when the speaker area, in square inches, is greater than the resonant frequency.

Ordinarily, the best procedure is to buy the speaker you want, decide on the value of A, and then find the volume required. Once the volume is known, you can decide on the shape of the enclosure to fit your needs. In finding A, use the *active* speaker area. This is the area out to, but not including, the first corrugation at the cone edge. The author's 15-inch speaker has an active diameter of only 12.5 inches. Once the port area is determined, the required volume can be found by:

$$V = 2992A/f^2(d + 1.13\sqrt{A})$$

again with all dimensions in meters.

Just a note at this point. The volumes of the enclosures discussed have been calculated from chosen values of port areas. In order that the port areas would be the same as speaker areas, typical values of active cone diameters were selected for several sizes of speakers and the active cone areas calculated.

Since speakers vary widely in construction, the active diameters and hence the calculations are only approximate. Moreover, all the data in Table 2 was calculated using a value of zero for the diameter, the thickness of the cabinet wall. From the equation for volume it is obvious that the thicker the cabinet wall, the smaller will be the volume required.

While the data given in the table is a close approximation of the correct volumes, it is not a substitute for individual calculations. Each particular speaker and enclosure must be calculated individually.

Because the author's enclosure is part of a TV set and bookcase combination, ½-inch plywood was used to keep the weight down. Three-quarter-inch or one-inch plywood is preferable. The builder's enclosure should be rectangular with at least one long front dimension. Don't make the depth too shallow, but try to avoid having any two dimensions the same. The author's is 20 x 22 x 30 inches inside. Use *both* glue and screws to put it together. Internal braces should be placed diagonally across each surface to reduce vibration.

The speaker and port should be at the ends of the long side, and it doesn't matter whether the enclosure is upright or on its side. If it is upright, move the port up from the floor a few inches. Don't use a shelf inside because this divides the volume into two acoustically-coupled resonators and will necessitate a return to cut-and-try methods to determine the shelf and port size. To avoid unwanted box resonance from the parallel surfaces, line the inside with some soft sound-absorbing material. The author used cotton because it is cheap and light, but better materials are available. Finally, don't forget to subtract the volume occupied by the speaker, braces, and soundproofing. —30—

Table 2. Approximate dimensions calculated for a few of the more popular speaker sizes. As mentioned in text, no allowance was made for thickness of cabinet wall.

SPEAKER	6″	8″	10″	12″	15″
A (square inches)	19.65	33.25	51.50	78.50	123.00
FREQ. (cps)	VOLUME (in cubic feet)				
	6-INCH	8-INCH	10-INCH	12-INCH	15-INCH
50	4.201	5.365	6.800	8.380	10.520
60	2.911	3.805	4.720	5.815	7.160
70	2.140	2.796	3.468	4.272	5.360
80	1.640	2.140	2.660	3.270	4.110
90	1.290	1.690	2.097	2.585	3.245
100	1.050	1.370	1.702	2.095	2.630

Sun-Powered Radio

The Admiral radio with the "Sun Power Pak" is shown here. 32 silicon cells comprise the power pack which is shown in the small zippered case on the right.

The world's first commercial sun-powered radio is also completely transistorized and will work off 6 drycells.

MARKING the culmination of over 18 months of research and development work, the *Admiral Corporation* recently introduced the world's first sun-powered tubeless radio designed for the consumer market. The silicon solar battery used to power the new radio is the first such device designed to convert useful amounts of the sun's energy directly and effectively into electricity for radio. The transistor radio itself without the sun power pack retails for $59.95. The sun power pack is priced at $175.00.

The *Admiral* set contains six transistors in place of vacuum tubes. The "Sun Power Pak," as an optional accessory, plugs into the back of the unbreakable cabinet, cuts out the conventional batteries, and converts the sun's rays instantaneously into electrical energy. The unit is so sensitive that it can also operate satisfactorily on overcast days.

The solar battery consists of 32 individual quarter sections of silicon solar cells, each of which can convert sunlight into electrical power with a much higher efficiency than has been achieved with any previous photovoltaic device. The silicon battery converts more than 15 per-cent of the energy it receives from the sun directly into electrical power. The solar cells are made from pure silicon which has first been treated with a small amount of an impurity so that it becomes "n", or negative, conductive material. It is then subjected to a gaseous atmosphere so that a controlled amount of "p", or positive conductive impurity, will diffuse into a very shallow layer (1/10,000th inch in depth) on the surface of the crystal. This process results in a "p-n" junction which is very sensitive to light. Photons of light energy, striking the surface of the silicon crystal, split off an electron from its normal position in the crystal lattice, leaving a positively charged "hole" or vacuum space. Both the electron and the "hole" will then be available for the conduction of electricity.

The solar cells in the power pack are encased in a block of clear plastic with a silicon oil center. The block measures approximately 6 inches long, 4 inches wide, and ½ inch thick. The plastic covering and oil center allow the best focusing of solar energy on the surface of the silicon cells.

The 32 cells are series connected to deliver a total of 9 volts at 15 milliamperes. Each quarter cell is capable of delivering 4.5 milliwatts of power. The solar cells are most efficient when exposed to light of the upper spectral region ranging from red to infrared. For demonstration purposes, the "Sun Power Pak" can be activated equally well by an artificial source of light such as an electric bulb or an infrared lamp. The unit can operate over a wide range of temperatures from 185 degrees Fahrenheit to minus 60 degrees Fahrenheit. It is protected from shock damage by the silicon oil center and strong plastic outer shell.

Although silicon is one of the most abundant elements on earth, being found everywhere in sand, pure silicon is very scarce and presently costs over $300 a pound. The solution to the present high price depends on the ability of metallurgists to find a better and less costly refining method. Solar batteries are expected to cost considerably less after producers effect manufacturing efficiencies and get into mass production.

The transistor radio itself contains six transistors, plus one detector and one a.g.c. crystal diode. It has a maximum power output of 250 milliwatts, with a sensitivity of 175 microvolts.

Without the "Sun Power Pak," the *Admiral* tubeless radio can be operated by six ordinary flashlight batteries costing less than one dollar. Since the set requires less than 1/10th the power consumed by a conventional portable radio, the flashlight batteries will last from 700 to 1000 hours before requiring replacement.

Printed wiring is used throughout the chassis of this set. Another feature is the rotatable antenna which pops up under the handle at the touch of a button and may be oriented for best reception. This allows the radio itself with its speaker to be in a fixed position, facing the listener. —30—

New Techniques for Repairing Portable Sets

By JAMES A. McROBERTS

This is the portable radio season and you can keep them operating if you keep up-to-date on the latest techniques.

MODERN three-way portable radios require some special servicing techniques because of their compact design and some of the recent developments they incorporate. High "*Q*" antennas have replaced the more cumbersome loops of the earlier models, and dry rectifiers have almost completely superseded tubes. Transistorized models are appearing in increasing numbers and some of their troubles are the same as those encountered in the tube types treated here.

Oscillator Failure

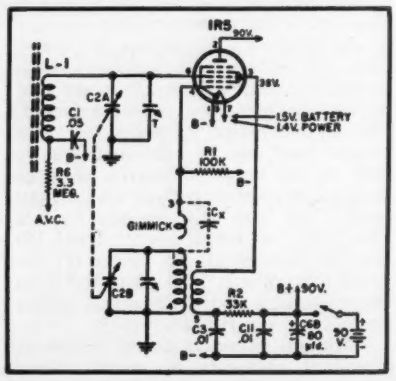
Portables, either straight battery or three-way, suffer oscillator failure frequently. The most usual symptom is a set that sounds alive but offers no reception. Touching the stator of the tuning capacitor r.f. or oscillator section produces a click in the speaker and noise comes through, but alas, no signals from stations. Several faults in the oscillator circuit will cause this condition, refer to Fig. 1.

Such sets almost invariably employ a type 1R5, or equivalent, as a converter. This tube is extremely critical as to its screen voltage and will tolerate only about a 15% drop. In the circuit illustrated, the tolerance is about 5 to 6 volts below the nominal 38 volts with fresh batteries, or normal power line operation. All voltages in this circuit should be checked with a high-resistance voltmeter.

The type 1R5 is equally critical with respect to its filament voltage, or even more so. Normally, it is run at 1.5 volts or a trifle under for long tube life, not less than 1.25 volts, however, for stable oscillator operation. The tube will perform as a mixer and the i.f. tubes will function in such sets with a filament voltage as low as 1 volt. But for the oscillator, instability and erratic operation sets in when the filament receives about 1.15 to 1.2 volts, depending on the applied screen and plate voltages.

Measurement of the filament, screen, and plate voltages is the first step whenever oscillator failure occurs. To correct for insufficient supply voltages, check the power supply. Pay particular attention to the screen dropping resistor (R_2 in Fig. 1), and screen bypass capacitor (C_3). Test the latter by shunting with a capacitor known to be good. (The test capacitor may be as high as .05 μfd.).

Fig. 1. Partial schematic diagram of a Motorola HS-454 3-way portable showing the converter stage. Note the "gimmick."



In addition to the screen bypass capacitor, test the power supply filter capacitors (C_{6B} and C_{11} in Fig. 1).

Another frequent source of oscillator failure in many of the modern oscillator circuits is the "gimmick" coupling capacitor. The trouble is always too little capacity between the "gimmick" and the oscillator coil (across terminals 1 and 3 in Fig. 1). The remedy is to insert a fixed capacitor between the two terminals as indicated by C_x in Fig. 1. The added capacitor may be about 25 μμfd.

It may be preferable to cut out the "gimmick" by breaking the coil lead with a penknife and using a 47 μμfd. or slightly larger fixed capacitor in its place. There is no chance that the "gimmick" can change its value again after this is done. Instead of a fixed capacity, a variable trimmer ranging from about 3 to 80 μμfd. may be used. Fig. 2 shows such a trimmer across terminals 1 and 3 of the oscillator coil. Adjust the trimmer screw until the oscillator starts working and then turn in the screw (increasing capacity) about a turn and a half. More capacity must be provided than just enough for the oscillator to start.

Another reason for removing the "gimmick" completely after inserting a conventional capacitor is that the "gimmick's" additional capacity may cause the oscillator to "squeg." This occurs if the grid capacitor or grid leak resistor is too large. (The grid leak resistor can be checked with an ohmmeter. If it is considerably larger than the schematic demands, replace the resistor.)

If a bypass capacitor is used from the filament of the oscillator tube to chassis or "B—," as shown in the oscillator circuit of Fig. 3, it can cause erratic oscillation. This is C_{20}, .05 μfd.

Try shunting it if oscillation is erratic. If it is replaced, be certain to remove the old capacitor.

"Loopsticks"

The trend has grown to the use of ferrite-core "Loopsticks" as a substitute for air-core loop antennas. The modern "Loopstick" is far more sensitive and selective due to its higher "*Q*." However, in a set using a "Loopstick," more care must be exercised in the tuning of the r.f. trimmer than was required for the air-core loop antenna with its broad response. For this reason, use care in replacing the leads to the antenna so that they maintain the same dress as before. Check the r.f. trimmer adjustment at about 1400 or 1500 kc. after any work on a chassis using a "Loopstick."

Particular attention should be given to mounting a "Loopstick" when it replaces a conventional loop—a desirable and feasible job when an older model portable is being serviced. The "Loopstick" should not come closer than an inch to any metal object. Mount the "Loopstick" so that it cannot wobble or shake; this causes "fluttering" as the set is carried or moved. This rigidity also applies to the leads from the "Loopstick" to ground and to the r.f. stator plate of the tuning capacitor.

Portables already equipped with ferrite-core loop antennas may give trouble due to the fact that this antenna may have too much minimum capacity for the circuit. This is particularly true of the long slender type of antenna shown in Fig. 4. This antenna stick was removed to service a complaint of poor high-frequency response. Some wire was removed, and the turns were spaced farther apart lowering the self capacity of the coil. In addition, the wire shown running along the coil was dressed away from the coil. These modifications and dressing the leads away from metal, particularly the lead to the stator plate of the variable capacitor, enabled the set to tune nicely to 1650 kc., above the high frequency end of the broadcast band.

Optimum spacing of the turns in an antenna for minimum self capacity is about the width of a turn. This spacing is most important at the "hot" end of the coil, *i.e.*, the end that is connected to the stator plates. Do not disturb any turns under the coupling coil if the portable uses a transistor oscillator since the low impedance input must be maintained.

When installing a "Loopstick," see that it is not shielded by metal. This includes the chassis frame, the speaker, and the batteries. The antenna should have as much clearance from metal objects as possible along its axis (length).

Fig. 5 shows a "Loopstick" with an adjustable core. The core is a ferrite slug for tuning the "Loopstick." The preferred frequency at which to adjust the slug core is about 900 kc. The slug should be adjusted so that reception sensitivity is about the same at 600 kc. as at 1000 kc. in those sets not equipped with an r.f. padder—and few are! Adjust the high-frequency trimmer on the gang capacitor in a manner similar to oscillator alignment, *i.e.*, tune the low frequency padder or slug, then the high, then readjust the low, then back to high, repeating the cycle until the best results are obtained. Always stop with a high frequency adjustment. In no case should the oscillator trimmer be adjusted.

An alternative to the preceding method for tuning the r.f. precisely is to bend the end plate sections of the ganged tuning capacitor. This can often help appreciably at the high frequency end when the desired minimum capacity is difficult to obtain.

Power Supply Troubles

During power line operation, the filament supply of a three-way portable

(*Continued on page* 86)

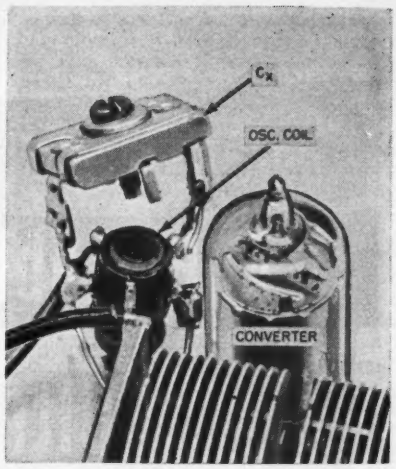


Fig. 2. Shown here is the addition of a trimmer capacitor to an oscillator coil to replace the "gimmick" which was formerly used for grid coupling. See text.

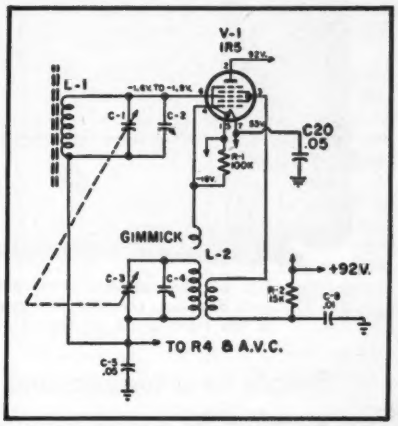
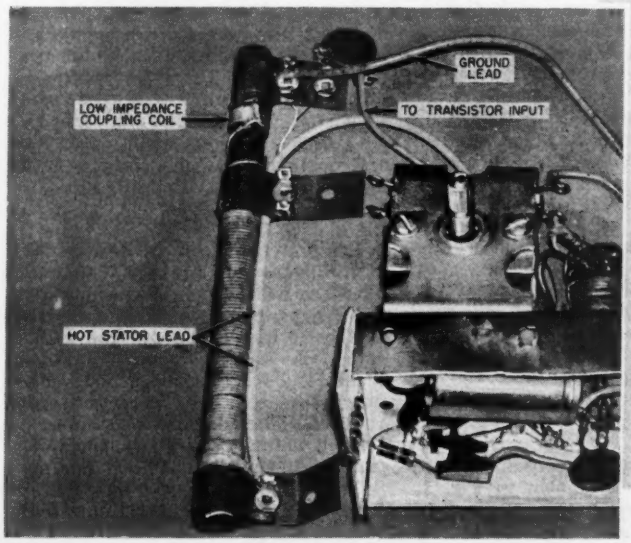


Fig. 3. Oscillator circuit of the Emerson model 830B portable. Note that the a.v.c. is applied to the frame of the variable capacitor; accidental application of a positive voltage to the frame makes the oscillator behave erratically.

Fig. 4. Ferrite core coil used with a transistor set. Note low-impedance coupling coil—do not disturb turns under it.



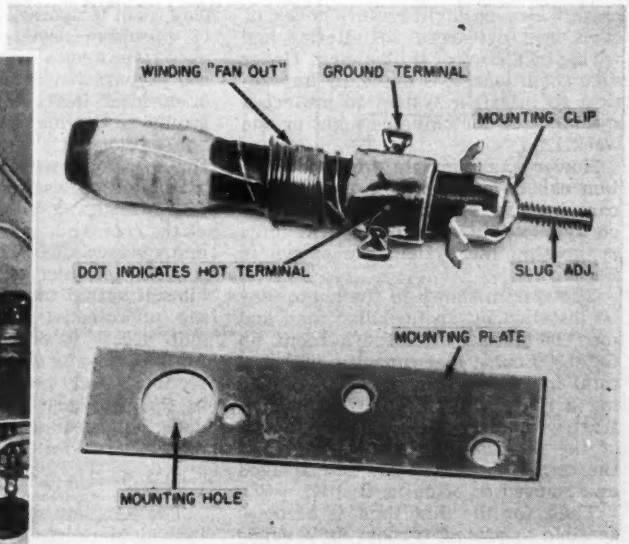


Fig. 5. Adjustable "Loopstick" shown with a mounting bracket to replace an air loop.

A Portable Ultrasonic Protection System

By LOUIS E. GARNER, JR.

Fig. 1. The complete ultrasonic protection system can be housed in a compact, portable p.a. system type carrying case. The unit at the right is the portion of system installed at guard's station.

Details on a compact and foolproof unit which can be installed by a novice and used by untrained personnel.

MOST intruder protection systems, whether of the photocell type, the foil and door contact type, or of the capacitance type, require considerable installation time. To properly protect a room might require hours, or even days, of careful installation and wiring by a crew of skilled men. Under such conditions, it is naturally impractical to install a system to protect a specific area for only one night or one week.

However, a complete protection system can be contained in an amplifier carrying case which can be transported by one man. The component units comprising the system are shown in Fig. 1.

The system shown in the photo may be installed by an unskilled man and may be used to protect a room up to 20,000 cubic feet capacity, with the total installation time seldom exceeding a half-hour! In addition, in contrast with many systems where much of the material used is irrecoverable, the complete system can be salvaged and re-used as often as desired.

Thus, for the first time, it becomes feasible to protect a room for a single night (although the system may be left in place for semi-permanent protection running into weeks or months, if desired). Applications are numerous. It may be used to protect a conference room during a period of classified conferences, may be used to protect a display room temporarily during showings of expensive jewels or furs, may be used to protect a drafting room during the preparation of classified drawings or sketches, in short, in any application requiring the maximum in protection "on a moment's notice" and without the need for a permanent installation.

In addition, as we shall see, protection is achieved within the entire area of the room, not just around the doors and windows. Thus, it is impossible for a potential thief or agent to secrete himself within the protected area during unprotected hours, and then to gain access to either material or information while the room is under protection. A body moving anywhere within the protected area is immediately detected and an alarm given at the remote guard location.

Units in System

The complete system consists of four individual units, as shown in Fig. 1. All are contained within the carrying case as shown with two of the units mounted permanently within the "halves" of the case.

An ultrasonic transmitting transducer pan is mounted in one half of the case, while a similar receiving pan is mounted in the other half of the carrying case, in the positions normally occupied by loudspeakers.

All the electronic circuits necessary to the operation of the system are contained in the amplifier foundation shown at the left in Fig. 1, while the remote "guard panel" is shown at the right.

The four units comprising the system can be interconnected easily and quickly by means of plug-in cables, so designed that no error can be made in connecting the units, even by an inexperienced man.

In the view of the guard panel shown in Fig. 1 (right), all the controls used by the guard in supervising and operating the system are easily identifiable in this illustration.

Principle of Operation

The protected room is literally filled with ultrasonic vibrations emanating from the transmitting transducer pan. The frequency of operation is approximately 19 kc., well above the audible range. At this frequency, the wavelength is a fraction of an inch so that every surface in the room acts as a reflector. The multiple reflections thus formed actually fill every "nook and cranny" in the room.

These ultrasonic vibrations are, in turn, detected by the receiving pan and the frequency of the received signals

compared with those of the transmitted signals.

As long as the two signals have the same frequency, as will always be the case under normal operation, no alarm is given. Should there be a moving body within the protected area, however, a Doppler shift in frequency will occur, and the frequency of the received signal will no longer be the same as that of the transmitted signal. The difference in frequency is detected and an alarm given.

In practice, the sensitivity can be set so that even "waving a hand" *anywhere* within the protected room will give an alarm.

Circuit Description

The complete schematic diagram of the electronic circuits necessary for the operation of the system is given in Fig. 2. The power supply circuit is not shown, since a conventional supply using *RC* filtering and full-wave rectification is employed.

Ultrasonic signals are generated by the series-fed Hartley oscillator V_4. These signals are applied to the transmitting transducer by coupling directly to the oscillator transformer T_2 by means of a secondary winding on the transformer. Low impedances are used to minimize loss over the shielded cable connecting the transmitter to the main chassis.

A small portion of the ultrasonic energy is coupled to a diode mixer through capacitor C_{19}.

Ultrasonic energy within the protected area is detected by the receiving or "pick-up" transducer and the electrical signals thus produced fed to the shielded input transformer T_1. The higher amplitude signals appearing across the secondary are applied to the grid of resistance-coupled amplifier V_1.

V_1 is a two-stage resistance-coupled amplifier with signals appearing across R_2 being applied through C_3 to the grid of the second stage. R_6 is used as a *sensitivity* control, as we shall see later, but is relatively ineffective at the 19 kc. signal level due to the bypass action of C_5.

Further amplification of the ultrasonic signal occurs in the second stage, with the amplified signal appearing across R_5.

R_3-C_2 and R_7-C_{12} provide the conventional cathode bias for the amplifier stages, while R_4-C_4 provides plate decoupling for these two stages.

The ultrasonic (19 kc.) signals *are not applied to* V_3 because R_8-C_{13} form a low-pass filter. Rather, these signals are applied through C_6 to a high-pass filter consisting of C_9, R_9, C_7, R_{10}, C_9, and R_{11}. Finally, the picked-up ultrasonic signals are mixed with the signal obtained from the oscillator (through C_{19}) by the diode mixer in V_4.

As long as the picked-up ultrasonic signal and the locally generated signal have the same frequency, no beat note is produced by this mixing action.

Should there be a moving body within the protected area, however, a Doppler shift in frequency will occur and the picked-up signal will no longer be the same as the transmitted signal. Under these conditions, a beat note, consisting of both sum and difference frequencies, will occur due to the mixing action of the diode in V_4. The difference is generally less than 100 cps.

The difference signal is applied through a low-pass filter network consisting of R_{13}, C_{10}, R_{14}, and C_{11}, through capacitor C_{22} where it appears across R_1. The low-pass filter eliminates any possibility of either the 19 kc. signals or the sum frequency signals being applied over this path.

Thus, the low frequency (less than 100 cps) as well as the high frequency (19 kc.) signals are both amplified by the two-stage resistance-coupled amplifier V_1. The "sensitivity control," R_6, is effective only as far as the low-frequency signals are concerned, however (except when near the ground end of its travel). Using a tube or stage to provide two functions, as in this manner, is known as "reflexing." (Note: "Reflexing" used to be quite popular in the design of receiver circuits, and is still used extensively in European design.)

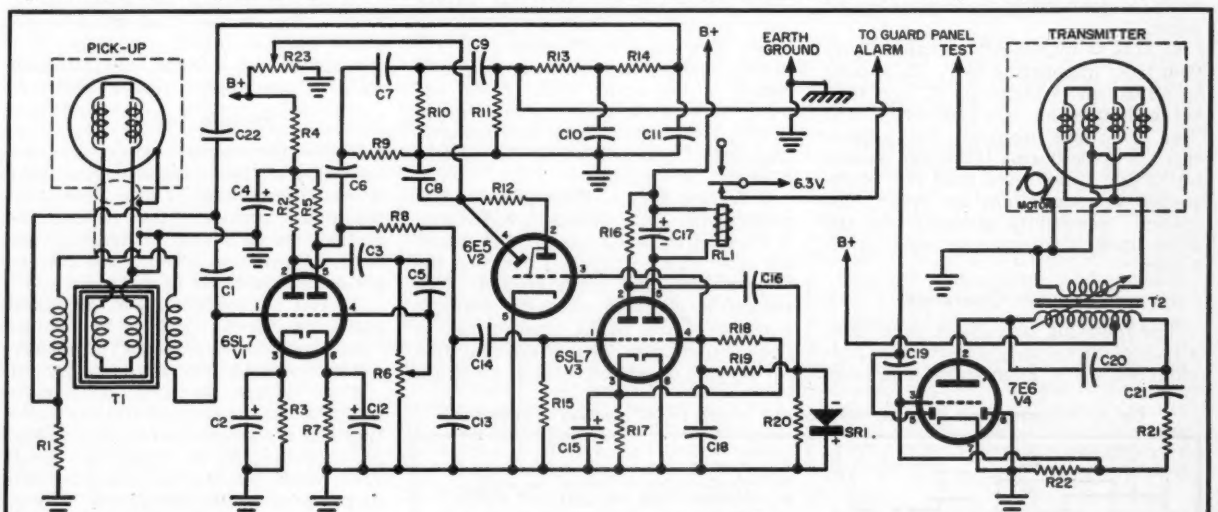
Amplified low-frequency signals appearing across R_5 can be applied through R_8 and C_{14} to the grid of one-half of V_3. Further amplification takes place in this stage, with the amplified signal appearing across R_{18}. R_{17}-C_{15} provide conventional cathode bias for this stage.

The signals across R_{18} are applied through C_{16} to the small selenium rectifier SR_1, where a bias proportional to the amplitude of the low-frequency signals is developed, appearing across R_{20}.

R_{19}-C_{18} provide filtering so that pure d.c. is applied to the grid of the second half of V_3. In addition, the time constant of R_{19}-C_{18} is such that there is a slight delay both in the application and the removal of the bias developed in this manner.

The second half of V_3 serves as the "alarm relay" control tube. Under nor-

Fig. 2. Schematic diagram of the transmitting and receiving transducers. A conventional power supply is required but not shown.



R_1, R_{11}, R_{15}, R_{19}, R_{20}—1 megohm, ½ w. res.
R_2, R_5, R_{18}—250,000 ohm, ½ w. res.
R_3, R_7, R_{17}—5000 ohm, ½ w. res.
R_4—100,000 ohm, ½ w. res.
R_6—1 megohm pot ("Sensitivity")
R_8, R_9, R_{10}, R_{12}—500,000 ohm, ½ w. res.
R_{13}, R_{14}—200,000 ohm, ½ w. res.
R_{16}—4.7 megohm, ½ w. res.
R_{21}, R_{22}—20,000 ohm, ½ w. res.
R_{12}—1 megohm pot ("Eye Sensitivity")

C_1, C_3, C_6, C_7, C_9—500 μμfd. mica capacitor
C_4, C_{12}, C_{15}, C_{17}—10 μfd., 25 v. elec. capacitor
C_2, C_{10}, C_{11}, C_{22}—.01 μfd., 600 v. disc ceramic capacitor
C_5—10 μfd., 250 v. elec. capacitor
C_8, C_{16}, C_{18}—.1 μfd., 600 v. capacitor
C_{13}—.05 μfd., 600 v. capacitor
C_{14}—.02 μfd., 600 v. capacitor
C_{19}—10 μμfd. mica capacitor
C_{20}—.0025 μfd. mica capacitor
C_{21}—.001 μfd. mica capacitor

T_1—Special input transformer (see text)
T_2—Special oscillator-output transformer (see text)
SR_1—Small selenium rectifier (see text)
RL_1—Sensitive relay (see text)
Motor—Small 6-volt (a.c.) test motor (installed in transmitter "pan")
V_1, V_3—6SL7 tube
V_2—6E5 tube (tuning eye)
V_4—7E6 tube

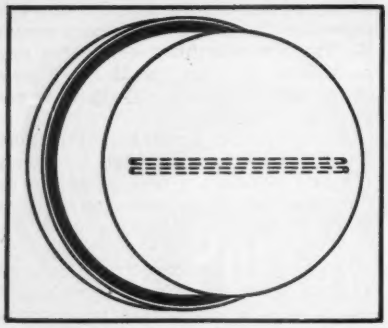


Fig. 3. Schematic representation of transducer pan. See text for full explanation.

mal operation relay RL_1 is kept closed by the plate current of this tube. Sufficient plate current to keep the relay closed is assured by the slight positive bias obtained across R_{17} and applied through R_{18} to the grid of the control tube. Capacitor C_{17} is used to prevent relay "chatter."

When a low-frequency beat note signal is produced by movement within the protected area, the bias developed across R_{20} cancels the small positive bias applied to the grid of the relay control tube, permitting the relay to drop out, and thus initiating an alarm.

The design is thus self-supervising. Should V_3 burn out, or the relay control open, or the power supply fail, or an attempt made to switch the protection system "off," RL_1 will drop out, giving an alarm.

Tuning-eye tube, V_3, is connected to the grid of the relay control tube and thus acts to monitor the voltage applied to the grid. Used in this fashion, it permits adjusting the sensitivity of the system to the desired point when making an initial installation, without need for connecting the remote guard panel.

C_8 acts to bypass a.c. signals to prevent their application to V_3. R_{22} is used to adjust the voltage on V_3 and thus serves both as an "eye sensitivity" and "eye brightness" control. This adjustment is made during the initial assembly of the system and need not be repeated as installations are made. The system "sensitivity control," on the other hand, is adjusted for each installation.

Transducer Operation

The receiving transducer consists of a pair of nickel magnetostriction rods mounted on a cylindrical aluminum pan approximately 6½" in diameter and 2" deep. A coil of fine enameled wire is wound directly on the rods. Coupling between the magnetostriction rods and the front of the pan is accomplished by means of small metal brackets, designed to be a quarter wavelength long (mechanical) at the frequencies involved, and thus to give a good impedance match.

The schematic representation of the transducer pan is given in Fig. 3, with the magnetostriction rods shown dotted.

The transmitting transducer is similar, except that a double pair of magnetostriction rods are used. The pan itself is the same size.

In operation, ultrasonic electrical energy applied to the coil of the transmitting transducer changes the magnetization of the nickel rod, causing minute changes in the length of the rod. These mechanical changes are, in turn, transmitted to the face of the pan by means of the quarter wavelength brackets. From here the pan face vibrations are changed into ultrasonic vibrations in air.

At the receiving transducer, the operation is just the opposite. Ultrasonic vibrations striking the face of the pan are transmitted as mechanical vibrations to the magnetostriction rod. Changes in the length of the rod cause changes in the magnetization which, in turn, result in flux linkages producing an electrical ultrasonic signal in the coil wound on the rods.

To increase the efficiency of operation, the nickel rods are given a permanent magnetization "charge."

The Guard Panel

The guard panel is used to give a remote indication of conditions within the protected area and, as we shall see later, also to provide means of remotely testing the operation and efficiency of the entire system. An exterior view of the guard panel is given in Fig. 1, while the complete schematic diagram of this portion of the system is shown in Fig. 4.

Referring back to the schematic diagram of the main chassis, given in Fig. 2, we see that when relay RL_1 is closed, 6.3 volts (a.c.) is applied between the "alarm" line and earth ground. This voltage is obtained from the filament winding of the power transformer in the main chassis. This is the condition for normal operation. Should an alarm occur, RL_1 opens, removing this voltage from the line. The voltage will also be removed should the power source at the main chassis fail, or should someone cut or short the alarm line. Thus, the line between the guard panel and the main chassis is, itself, supervised against tampering.

At the guard panel (Fig. 4), the 6 volt a.c. signal obtained from the alarm line is applied to a small bridge rectifier (standard instrument rectifier). The d.c. thus obtained is applied through R_{24} to the guard panel alarm relay RL_2 and holds this relay energized.

R_{24} is chosen so that the current normally flowing through the relay coil is sufficient to hold the relay closed, but not sufficient to energize it, once opened. This resistor can be shorted by push-button switch S_1, which acts as a "push-to-reset" switch. This makes it necessary for the guard to go to the panel and push the reset switch whenever an alarm occurs, thus preventing a lazy guard from ignoring the alarm.

While RL_2 is closed, 6 volts, obtained from transformer T_3, is applied to PL_2, the green bullseye, "normal" or the "Monitor" light. (See Fig. 1.)

When an alarm occurs, RL_2 is deenergized, opening the "Monitor" light circuit, allowing this pilot to go dark, and closing the PL_3 red "Warning" or "alarm" light circuit, lighting this pilot. At the same time, the alarm buzzer or bell, B, is activated, so that both a visual and an audible alarm is given.

While the guard panel is in alarm, the buzzer can be silenced by throwing switch S_2, but the buzzer will immediately sound again when the panel is set up for normal operation. Thus, it is impossible for the guard to so silence the buzzer that it will not sound when it should.

A switch operating in this fashion is called a "compulsory silence" switch.

Remote Testing

Unlike many protection systems, the operation of the complete system may be tested remotely at any time from the guard location. After testing, the system can be set up immediately for normal operation. The tests can be performed as often as desired.

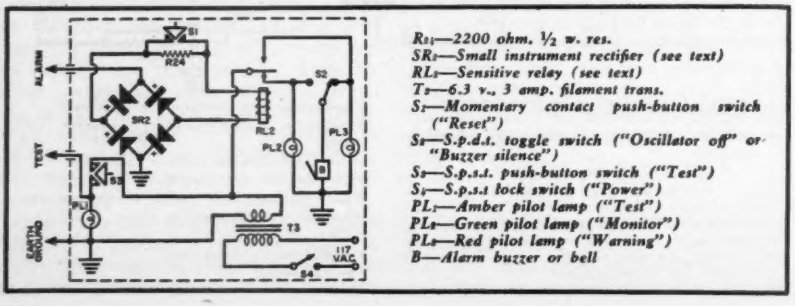
To test the system, S_3, in the guard panel, is closed, lighting the amber "Test" pilot light, and applying 6 volts a.c. between the "test line" and ground.

This voltage, in turn, operates a small motor located in the transmitting transducer pan (refer back to Fig. 2). Attached to the motor is a small vane which sets up the necessary disturbance to initiate an alarm.

Such a system works well, using ordinary telephone line, for distances up to about 250 feet. At greater distances the line drop in the "test line" requires that a small "test" relay be mounted on the main chassis. The "test" relay is then energized by the voltage applied to the test line and, in turn, ap-

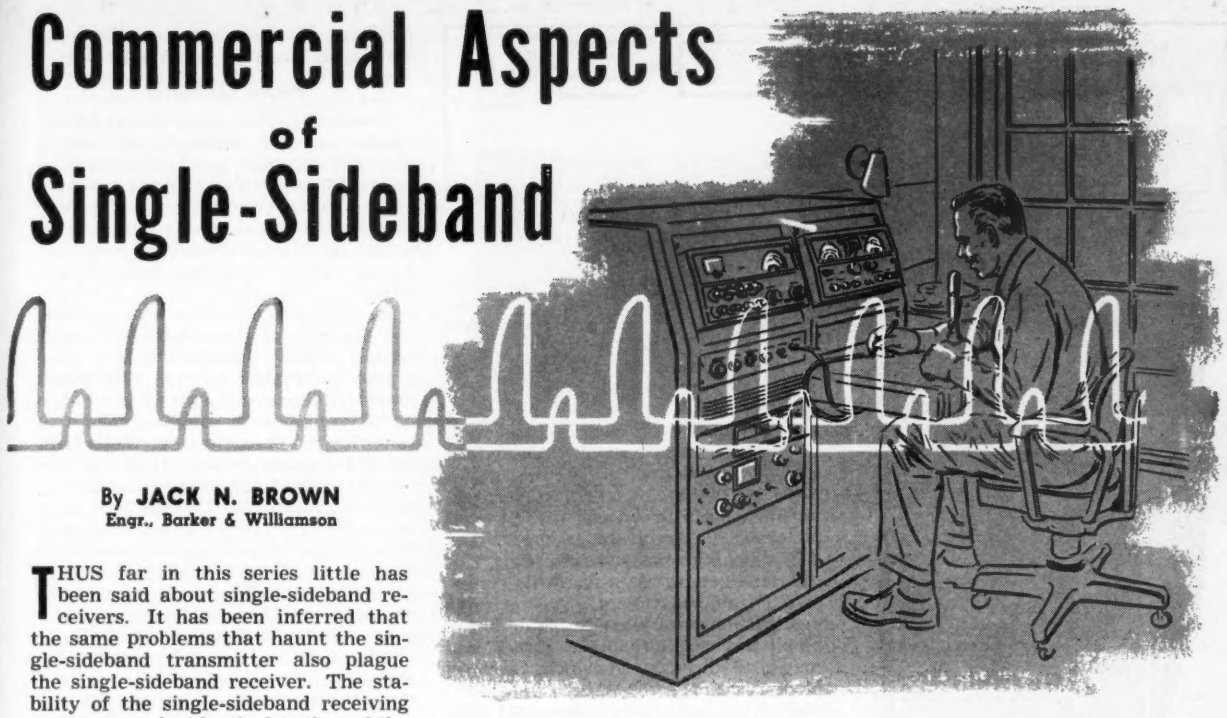
(*Continued on page* 121)

Fig. 4. Schematic and parts list covering the "guard panel" position of system.



R_{24}—2200 ohm, ½ w. res.
SR_2—Small instrument rectifier (see text)
RL_2—Sensitive relay (see text)
T_3—6.3 v., 3 amp. filament trans.
S_1—Momentary contact push-button switch ("Reset")
S_2—S.p.d.t. toggle switch ("Oscillator off" or "Buzzer silence")
S_3—S.p.s.t. push-button switch ("Test")
S_4—S.p.s.t lock switch ("Power")
PL_1—Amber pilot lamp ("Test")
PL_2—Green pilot lamp ("Monitor")
PL_3—Red pilot lamp ("Warning")
B—Alarm buzzer or bell

Commercial Aspects of Single-Sideband



By **JACK N. BROWN**
Engr., Barker & Williamson

Part 3. Concluding article covers SSB receivers, service procedures, test equipment, and an evaluation of system.

THUS far in this series little has been said about single-sideband receivers. It has been inferred that the same problems that haunt the single-sideband transmitter also plague the single-sideband receiver. The stability of the single-sideband receiving system must be identical to that of the transmitter in order to guarantee satisfactory performance. To take advantage of the reduced bandwidth transmitted by a single-sideband transmitter the SSB receiver must likewise have a restricted bandwidth. This not only increases the signal-to-noise ratio but also successfully discriminates against adjacent channel interference which might be of a serious nature.

Many modern conventional communication receivers have selectivity characteristics which are entirely inadequate for good single-sideband reception. Recently the design trend indicates that improved selectivity is in the offing and should shortly be available in many commercial receivers. The general trend is toward double—or even triple-conversion superheterodyne receivers. The steep skirt selectivity curves that are essential to good single-sideband reception are usually made available in the last i.f. stages of a multiple-conversion receiver.

Design engineers should remember that it is best to get the selectivity as close to the front end of the receiver as possible. This is often not practical, hence a reasonable compromise must be made. The current availability of mechanical filters in the 400 to 500 kc. intermediate-frequency region makes possible excellent selectivity characteristics in this part of the spectrum. Many receiver designers make use of a still lower intermediate frequency in order to obtain a rectangular selectivity curve. This last i.f. may be anywhere from 100 kc. down to 20 kc. and the filters in use under these conditions are generally identical to those used in low-frequency, filter-type single-sideband transmitters. These may be of the crystal lattice type or the toroidal coil type filter.

If selectivity is obtained at a second intermediate frequency it should be kept in mind that the overload characteristics of the first i.f. amplifier must be such that adjacent channel signals which do not fall in the passband of the last i.f. filter must not overload and cause intermodulation distortion products which would appear at the receiver's output. In general, this means that any amplifier, whether r.f. or i.f., which precedes the high-selectivity filter must be run at a reasonably low level so that signal voltage will not rise to a high enough level to cause intermodulation distortion. Once selectivity is obtained, normal high-gain stages may be used in order to achieve the final output level desired.

AM receivers can be successfully converted for SSB reception by the addition of an external adapter. This accomplishes double-conversion to a low intermediate frequency. The converted signal is then passed through a bandpass filter for increased selectivity, demodulated by beating against the carrier oscillator, and then amplified in the audio stages. See Fig. 1 for a block diagram of such a unit.

Single-Sideband Detection

Following the single-sideband receiving filter and amplification there must be a single-sideband demodulator with a carrier re-insertion frequency of high enough amplitude to achieve exalted carrier detection of the single-sideband signal. Some form of product detector[1] may be used if high carrier re-insertion voltages are not available. If an exalted carrier voltage of over ten times the peak value of the received single-sideband signal is available, either diode detection or mixer type demodulation may be used with little choice as to which is better. Whichever system is used, a low-pass filter must be employed to prevent the re-inserted carrier frequency voltage from getting into the audio amplifier stages.

Transceiver Type Installations

A transceiver-type single-sideband system is one in which transmission and reception is accomplished on the same frequency. It is possible to use the same injection frequency signals in both the transmitter and receiver heterodyning systems. This offers the advantage of always keeping a receiver and transmitter on exactly the same frequency. In addition, once the operator receives a distant single-sideband signal he knows that he is transmitting on exactly that same frequency. This is an obvious advantage for "netting" a group of single-sideband stations.

It is also possible to design transmitter and receiver circuits which are truly bilateral in operation so that the same components can be used, alternately, for both transmitting and receiving. This is a fairly complex problem and for the sake of circuit simplicity is not recommended where space and power limitations permit unilateral type equipment.

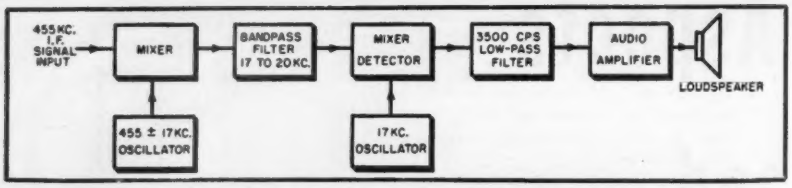


Fig. 1. Block diagram of a double-conversion type single-sideband receiving adapter which can be used to convert AM receivers to single-sideband operation.

Fig. 2. B & W Model 370 double-conversion SSB receiving adapter. The block diagram of unit is shown in Fig. 1 directly above.

Servicing Single-Sideband

For the organization that proposes to furnish single-sideband communications to a group of customers, the servicing problems involved are of a slightly different nature than for conventional AM equipment. Such service functions as periodic checks of vacuum tubes, power-supply voltages, and operating circuits will be similar to those performed on the older type equipment. Such items as alignment of phase-shift networks, checking distortion products, sideband suppression and peak-power output measurements are all problems that undoubtedly have not confronted the service engineer to date.

To properly service single-sideband equipment a few specialized pieces of test equipment will be required. Such equipment as a spectrum analyzer, a counter-type frequency meter, good r.f. vacuum-tube voltmeters, low-distortion audio oscillators, and a good test oscilloscope should be numbered among the pieces of test gear available to the technician. The photograph of Fig. 3 shows a typical test setup.

The Spectrum Analyzer

A panoramic-type spectrum analyzer is desirable for making initial alignments and periodic checks of single-sideband equipment. Such an instrument is manufactured by *Panoramic Radio Products, Inc.*[3] An appropriate model would be the Model SB-8A, type T-200. This unit allows the technician to examine the spectrum transmitted by a radio transmitter and permits the operator to observe the output frequency ±100 kilocycles. If he wishes to examine in detail the sideband components transmitted, he can do so by expanding the sweep to include the portion of the spectrum immediately adjacent to the signal being observed. In this case it is possible to separate sideband components which are only a few hundred cycles apart by increasing the resolution of the last i.f. amplifier of the spectrum analyzer.

The photographs shown in Part 1 of this series were taken from the screen of such an instrument. The operator has the choice of logarithmic or linear amplitude display of the signal and may read, directly in decibels, the level of the distortion products generated and of the intelligible suppressed sideband components being transmitted by the single-sideband equipment under test. To use such an instrument it is necessary to have a source of stable r.f. voltage, preferably from a stable signal generator, which must be fed into the spectrum analyzer at a frequency which is 500 kilocycles removed from the signal being observed. This is because of the i.f. and heterodyning system used in the spectrum analyzer, that is, the first i.f. amplifier frequency is at 500 kilocycles.

The variable selectivity is obtained by conversion to a second i.f. of 262 kc. where a double-section crystal filter is used. This filter bandpass is variable to accommodate various sweep widths and resolutions desired. An instrument of this type is invaluable to the technician in testing single-sideband equipment.

Frequency Measuring Equipment

Since frequency stability is of prime importance in single-sideband equipment, it is obvious that some means of measuring radio frequencies in the high-frequency spectrum must be available to the technician. The newer-type decade counters, currently available on the market, are ideal for this task. Such decade counters are manufactured by *Beckman Instruments*[3], *Hewlett-Packard*[4], and others.

The direct-reading frequency meters are so convenient that the advantages of using such gear are too obvious to mention. Using such an instrument permits the technician to check, in a matter of seconds, the exact frequency of the transmitter under steady or discontinuous type transmissions. If any instability exists it is quickly detected and the technician can, by the process of elimination, determine which of the various heterodyning oscillators is causing the trouble.

Audio Oscillator

The use of a low-distortion audio oscillator is very necessary in making distortion product measurements on a single-sideband transmitter. Distortion on the order of one-half of one percent or less is necessary in order to make intelligent distortion measurements on a single-sideband transmitter.

In making a two-tone test to check the linearity of the amplification system of a SSB transmitter, it is generally acceptable to use re-inserted carrier and one audio tone fed into the audio amplifier to make up the two tones for the linearity test. When both tones are equal in amplitude and the output of the transmitter is monitored on an ordinary oscilloscope, the pattern shown in Fig. 4 will be seen. This is not to be confused with the pattern for 100% modulation that is normally seen on a conventional AM transmitter. If any flattening of the peaks of Fig. 4 is apparent, the amplifiers are being overdriven or are seriously under-loaded as far as the output circuit is concerned. If the crossover shape at the center of the scope pattern is not a sharply defined "X", the bias on one or more of the amplifier stages is misadjusted and therefore should be decreased to avoid operating on the "knee" of the tube characteristic curve. By simple observation of the output envelope of a single-sideband transmitter it can often be quickly determined which of the various sources of distortion is causing trouble.

Observation of the transmitter output by a spectrum analyzer, however, will not tell the exact cause of the distortion products but will only tell to what extent distortion products are being generated. Therefore, it is necessary to use both the spectrum analyzer and oscilloscope observation of the transmitter r.f. output envelope.

Using the oscilloscope to observe the normal operating output waveform is also necessary when adjusting any automatic modulation level control or speech clipper circuit. This should be set conservatively so that restriction of the maximum swing of the transmitter output is just short of the maximum range available on peak output power. The slight amount of audio distortion that is inherent in a speech limiter or speech clipper is tolerable. If conservation of spectrum space is to be accomplished with single-sideband techniques, proper use must be made of all spectrum limiting circuits.

Operational Problems

The main operational problems that will confront the user will be during the transition period when both AM and single-sideband equipment may be in use by subscribers using the same or adjacent channels. If it is possible to convert all stations of an operating system to single-sideband simulta-

neously, the main operating difficulties would be avoided. This will not always be possible and therefore it will be necessary to operate single-sideband and conventional AM transmitters in the same network and on the same frequencies.

It should be obvious to the engineer that single-sideband equipment can be used for receiving AM signals if the AM signal itself has a frequency stability that meets the stability requirements of the single-sideband system. The single-sideband receiver operator has the advantage of being able to select either sideband of the transmitting AM station in the event of interference so that he may be in a better position to copy the AM signal than another AM-equipped receiving station. Under many conditions an AM-equipped station will find it impossible to copy a single-sideband transmitter without some special provisions being made. Such provisions may include an artificially inserted carrier in the AM receiver either by use of a beat frequency oscillator (b.f.o.) or by the addition of a single-sideband receiving adapter on the tail end of the AM receiver. Such adapters (Fig. 2) are currently available for receivers using standard intermediate-frequency systems. These offer selectable sideband reception with excellent selectivity characteristics.

It would also be possible, in many cases, for the single-sideband transmitting station to re-insert carrier and transmit single-sideband with carrier so that the receiving AM station could properly demodulate the signal in a conventional manner without the use of any special SSB receiving techniques. This would appear to be the easiest system for utilizing both single-sideband and AM equipment in the same net. This, however, has the disadvantage of compelling the SSB operator to run lower than normal power output when using single sideband-*suppressed carrier*. This is so because when he transmits a carrier with his SSB signal the power capabilities of the linear amplifiers are greatly reduced by the presence of the continuous carrier. Generally, if a transmitter is rated at 100 watts peak envelope output under normal SSB transmission the operator will find that he will be able to run only 30 watts output using carrier with one sideband. This is a rather obvious disadvantage as far as the SSB operator is concerned. He is no longer making maximum use of the equipment as designed for SSB service.

Another operational problem that will undoubtedly arise when using single-sideband equipment is the problem of "netting" a group of SSB stations when using the same frequency. Normally, under fixed-frequency commercial-type service crystal-controlled equipment would be used. A small amount of frequency vernier control should be made available at the front panel of the transmitter-receiver equipment. If the single-sideband equipment

Fig. 3. Test position used to align sideband generator units. Equipment visible in photo includes a decade frequency meter, audio oscillator, receiver and SSB receiving adapter, and panoramic spectrum analyzer with a signal generator.

is of the transceiver type, both the transmitter and receiver will be controlled simultaneously by this frequency vernier knob. If the operator adjusts the vernier frequency control so that he receives the net control station correctly he then knows that he will be transmitting on exactly the same frequency as the net control station. If each operator in the net is careful to adjust his receiver to the frequency of the net control it is then obvious that all stations are on the same frequency. If the amount of frequency vernier control is kept to less than the maximum tolerance allowed by FCC regulation (currently .01%) unskilled operator alignment of the transmitter - receiver frequency would be possible without risking off-frequency operation. It then becomes obvious that if correct net frequency discipline is to be maintained, the net control station must at all times maintain its transmitter frequency near the middle of the FCC frequency tolerance permitted for the particular class of service. For many types of service it will probably be desirable to have absolutely no operator adjustment of the transmitter-receiver frequency. This should be possible with good quality crystal control for each available channel.

Expected Reliability

The many obvious technical advantages of single-sideband have been pointed out throughout this series. The final user is always interested in exactly how reliable a system is going to be from the standpoint of circuit outages due to weak signal conditions, equipment failure, and complexity of operation. Since very few single-sideband low-powered communication systems are currently in use the only operating experience that can be quoted is rather restricted. However, it can be stated that a correctly aligned SSB system will easily outperform a comparable AM system in all ways.

A single-sideband system will be immune to ionospheric propagation distortion. The problem of selective fading distortion that is ever present in a double-sideband AM signal is nonexistent with a SSB signal. Selective-fading distortion that is caused by multi-path propagation causes the carrier to be temporarily lost or one of the sidebands to fall out-of-phase with the other sideband. The familiar garble of the intelligence results. The SSB user will find that fading of the SSB signal causes only a variation in output volume and in no way tends to

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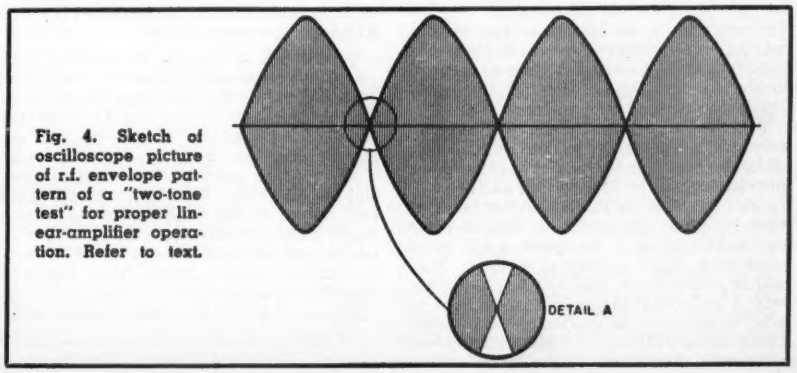
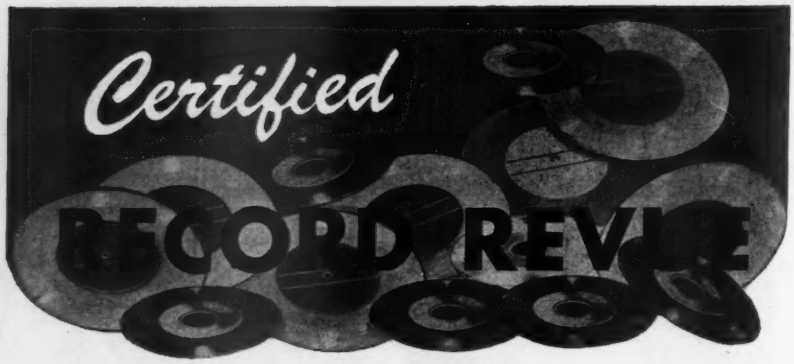


Fig. 4. Sketch of oscilloscope picture of r.f. envelope pattern of a "two-tone test" for proper linear-amplifier operation. Refer to text.



By BERT WHYTE

LAST MONTH'S introductory notes were devoted to a discussion of three-channel stereophonic sound. You may recall that I speculated on the possibilities of making this fabulous sound commercially available to the music-loving public. I acknowledged the rather staggering problems involved in bringing this sound to commercial fruition in the form of recorded tapes and machines upon which to play these tapes. I made what I hoped were some helpful and possibly stimulating suggestions. Quite frankly, I suspected that my ideas and suggestions would lie dormant and go unheeded for some time. Long time readers of this column will recall that I got up on my soap-box and beat the drums for *two-channel stereo and binaural* some years ago, and the antipathy and indifference of certain people who could have brought this sound into being then was a frustrating and maddening experience. Well, two-channel stereo is now well under way, but on the basis of the rocky road it had to travel, one could logically assume that the obstacles confronting the adoption of three-channel stereo are even more formidable, and will take a longer time to resolve.

Thus armored by my experiences with two-channel stereo and anticipating nothing but a long hard fight, you can imagine my stunned disbelief and pleasant surprise when I learned that one of the major problems blocking the commercial realization of three-channel stereo was well on the way toward solution! Yes, just a scant two weeks after I wrote last month's column plugging the three-channel stuff, the light of knowledge, the dawn of realization was already breaking! Now don't get me wrong! You won't be able to trot out to your favorite audio emporium next week and bring home the three-channel bacon for $99.50! *But,* the first big step has been taken . . . the die is cast . . . the show is on the road! What is so earthshaking? You will have to wait until next month to find out, because the report on this event requires special coverage. A monthly column rarely, if ever, has a "scoop," but I can promise you one next month. It is quite possible that for the first time in the history of this column we will use some photographs to further highlight the significance of this big step forward in stereophonic reproduction for the home. Don't miss next month's column!

Because the August column will have an extensive introductory section on the new stereo development, we may have to cut down the reviews a little. Due to that and due also to the fact that many readers are starting their vacations and will have time to catch up on their listening, this month I will try to cram in as many reviews as possible. They will be shorter than usual, but that's the only way I can bring the maximum number to you. Contrary to the practice of record companies in the summers of years past, there is very little diminishing of the flood of new releases. Indeed, there are so many that if one were so inclined and had the money to indulge himself, every moment of a two week vacation could be spent in listening. Those who like the Dodgers instead of Dvorak, won't care . . . for the listeners I'll try to bring them the mostest!

Equipment used this month: New *Gray* turntable, *Gray* viscous-damped arm, *Fairchild 225* cartridge, *Marantz* audio consolette, two 60-watt *McIntosh* amplifiers, *Jensen* "Imperial" speaker, *Electro-Voice* "Georgian" speaker. *Ampex* tape equipment.

MOZART

SYMPHONIES NOS. 36, 39, 40, AND 41

Chicago Symphony Orchestra conducted by Fritz Reiner. Victor LM6035. RIAA curve. Price $7.96. Two discs.

Here is a magnum sampling of Reiner's particular way with Mozart symphonies. And his way will find favor with many . . . not so much as impeccable performances, but as remarkable studies in orchestral textures and balance. Mozart wrote his symphonies for what amounts to a chamber orchestra and intended that they should be played in moderate sized salons. Time and circumstance have long since relegated them to the concert hall, where they have acquired larger orchestration and larger sound. Since everyone plays them thus today, Reiner cannot be taken to task, even though his is quite the biggest and most sonorous Mozart on records. The purists will prefer Beecham and Walter . . . but these are impressive performances with a vast, big-hall sound . . . yet with the inner detail clearly revealed. The orchestra plays wonderfully well, especially the strings and string tone is particularly luscious. This recording might best be characterized as "Mozart for the Hi-Fi Fan!" In any case, a creditable job and a good buy.

A HI-FI FROLIC WITH STRAUSS

Vienna State Opera Orchestra conducted by Anton Paulik. Vanguard VRS476. RIAA curve. Price $3.98.

The Strauss in this case as you may have guessed is Joseph and Johann and even lesser-known Eduard, but certainly not the formidable Richard! No one would dare be that frivolous with him! This is one of *Vanguard's* justly famous Viennese recordings and is every bit as good as "Vienna Bon-Bons" and the others that have been released. That past master of the bubbling, frothy Strauss music, Anton Paulik, again holds forth with rousing performances of ten polkas, a "Galop," a "Scherzo" and a lilting "Blue Danube." Superbly clean sound in keeping with the tradition of earlier recordings in this series. A frosty glass, a pretty lass, and this music adds up to a summer night delight.

FOLK SONGS OF THE FRONTIER

The Roger Wagner Chorale and soloists. Capitol P8332. RIAA curve. Price $3.98.

Well podnuh, this heah disc is yore ticket effen you is a-hankerin' for some cowboy ditties. Yessir, this has got 'em all, from "Home on the Range" and "O Bury Me Not on the Lone Prairie" to "Whoopee-Ti-Yi-Yo" and others. Seriously this is magnificent choral work, with all the colorful words completely articulate and with splendid balance between the various choirs and the soloists. *Capitol* affords the performers very wide range, ultra-clean sound and, with the utterly dead quiet surfaces, the illusion of presence is uncanny.

BALLET MUSIC FROM THE OPERAS

Philharmonia Orchestra conducted by Herbert von Karajan. Angel 35307. RIAA curve. Price $4.98.

Von Karajan follows up his good work in last month's "Pop Concert" with this potpourri of operatic ballet music. Sure there are potboilers here and very appropriate for summer listening, especially when they are well done as on this disc. In the "Dance of the Hours," the ballet music of "Aida," the "Dance of the Persian Slaves" from "Khovantchina," the "Venusberg Music" from "Tannhauser" and the "Prince Igor Dances" 8 and 17, Von Karajan displays his talents for orchestral color and gives us good vigorous readings. The Philharmonia plays splendidly and the sound, another of the newer, brighter, more "hi-fi" efforts by *Angel,* is quite thrilling. Outstanding brass, strings, and percussion.

SCHUMANN

SYMPHONY NO. 2 IN C MAJOR

Detroit Symphony Orchestra conducted by Paul Paray. Mercury MG50102. RIAA curve. Price $3.98.

Paul Paray scored a notable success with his reading of the Schumann 4th some time ago, and now he repeats that success with Schumann's 2nd. Many critics were surprised by Paray's performance of the Schumann 4th, a composer they obviously felt was outside of his usual repertoire. This would not be the first time that Paray has confounded the critics. He simply does not fit the classic mold the critics attribute to a French conductor. More than that, although many have questioned the authenticity of some of Paray's "out-of-repertoire" readings, none of them deny that his performances have their own strength and virtues. It is so in this Schumann 2nd. There is an extraordinary warmth, and an earthy vigor in the Paray perusal of the score, that is not matched by any of the existing recordings in the catalogue. Even in terms of sheer sound, this disc is beyond any of its competitors. The strings are smooth but quite bright, the brass crisp and the woodwinds very pure-toned. Add the spacious acoustics to the usual *Mercury* "close-up," highly detailed recording and the wide dynamics and you have the best Schumann 2nd now available.

TCHAIKOVSKY

SUITE NO. 3 IN G MAJOR

L'Orchestre de la Societe des Concerts du Conservatoire de Paris conducted by Sir Adrian Boult. London LL1295. RIAA curve. Price $3.98.

Relatively little known and certainly not one of Tchaikovsky's most athletic efforts, this "3rd Suite" has much that many people

(*Continued on page* 109)

The opinions expressed in this column are those of the reviewer and do not necessarily reflect the views or opinions of the editors or the publishers of this magazine.

Realistic High Fidelity

The Single-Cone Loudspeaker

By H. A. HARTLEY
Audio Consultant

Part 4. Design factors influencing loudspeaker performance and a discussion of the simple, diaphragm type reproducers.

EDITOR'S NOTE: *As is quite obvious, the opinions presented in this article are those of the author. Actually, there are quite a few individuals who, like the author, believe that the use of multiple small-cone speakers is preferable, for high-fidelity reproduction, to a large, single-cone unit. There are several facts that validate this thought. On the other hand, you will find many other individuals, including most U. S. speaker manufacturers, who believe the larger cone unit is the ultimate answer. They, too, can present reasonable arguments for its use. Some of these facts are obvious. Although the author has shown that, theoretically, the bass response of a small-cone speaker can be made as good as a large-cone speaker, the large voice-coil and cone excursions required present major manufacturing and performance difficulties. As a result, we do know that, considering present-day techniques, the bass response extends farther down (frequency-wise) as the cone size increases. On the other hand, the smaller speakers provide better coverage of the high end when compared with the larger single-cone speakers. For greatest frequency range, it is usually necessary to use a combination of one large-cone woofer and a high-frequency tweeter.*

DESIGNING high-fidelity loudspeakers is partly a science but very much a fine art. The requisite "know-how" has to be acquired the hard way—by making mistakes; in other words, the engineers who have made their mistakes and have profited from their experiences are in a position to contribute more to the industry than a newcomer. This seemingly untechnical approach is not an attack on science or straight-thinking, it is straight-thinking since a speaker cannot be designed by mathematics. It is a known fact that only the simplest actions of a speaker can be analyzed mathematically, such as an infinitely rigid diaphragm driven by a sine wave; but since musical reproduction, in all cases, results from an extremely flexible (speaking comparatively) diaphragm actuated by very complex waves, the motion of it and the sound emanating from it cannot be computed very readily. Putting it crudely, speaker design is a sort of inspired guesswork. Certain parts of the speaker, particularly the magnetic system, can be designed with great precision, but the thing that makes the noise, the voice-coil-cone assembly, cannot be treated in this tidy manner.

The home constructor and the enthusiastic amateur are at a serious disadvantage in the matter of speaker design, although many volumes have appeared dealing with the subject. Making a speaker is not easy, for in order to secure reasonable sensitivity, tolerances have to be close in the voice-coil, yet it is made from materials which do not lend themselves to fine limit construction. I shall assume, therefore, that in the matter of speakers you will buy something ready made. The problem is, therefore, which speaker to buy and how to use it.

Visual Assessment

Strange as it may seem, the performance of a speaker can be fairly well estimated merely by looking at it, if you know what to look for. This is due to the fact that experienced designers know that such and such an assembly of materials produces certain sounds and has certain defects (for no speaker is perfect). The wider the experience the more certain is the work of the designer, but it does not follow that a given manufacturer produces some specific model because the designer wanted it that way; the man who usually fixes the design is the sales manager, whether he is selling loudspeakers or automobiles. Fashion trends are created by advertising experts and the public trained to accept these fashions as the thing they ought to have. New ideas are created by original thinkers and competitors rush in as soon as the new feature has proved to be a seller and copy it, without having any clear notion of what they are doing. Others know full well what they are doing, but for the sake of novelty christen an accepted design feature with a new name.

I speak from direct experience of this sort of thing. Many years ago I came to the conclusion, after innumerable experiments, that the optimum cone size for an honest-to-goodness high-fidelity speaker was between 8 and 9 inches in diameter, according to the material used for the cone. That conclusion was forced on me by purely objective research. I have produced speakers having cones of this size for 25 years and they are well liked by those who have them; but my dealers tell me they could sell many more if it were a 12-inch speaker. What am I to do? Tell them, as I have been telling them for years, that if they want more power-handling capacity and more sound output they should use two or three of them or sacrifice performance to meet the requirements of a whimsical market? Actually my task now is to find out how to increase the size of the cone without spoiling the per-

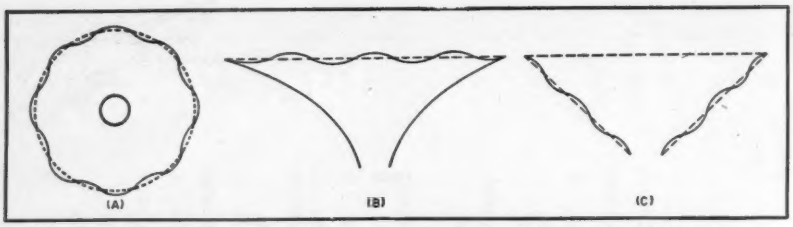


Fig. 11. The distortion of speaker diaphragms at low frequencies. (A) Nodes on a straight-sided cone. (B) Nodes on an exponentially-curved cone, and (C) wave motion along the sides of a cone. Refer to text for details on this.

formance of the speaker, and that involves a complete redesign. At any rate, the 12-inch speaker remains a project and nothing else until I can find a way of making a 12-inch cone behave as I want it to.

The following discussion, like my past experiments, is objective. Many will disagree with what I postulate as to the requirements of good design, and it may be that I am biased because I am a loudspeaker designer. But I said in my introduction that this series is devoted to high fidelity considered as a means of reproducing music with as little equipment coloration and distortion added as may be possible; the speaker is the worst offender, and my thesis is based on genuine research into creating speakers that have no "personality," speakers that are not better nor worse than other speakers, but don't sound like speakers at all.

Taking direct radiators first, loudspeakers that are mounted on flat or folded baffles, the first thing you see is the cone. This has four properties having bearing on its performance: diameter, included angle, shape of cross-section on the axis, and material.

I have said that my experiments have shown that the optimum size of cone is about 8 or 9 inches. Why should this be so? Since a diaphragm is not infinitely rigid it must distort when force is applied to it from the voice-coil. Major distortions occur in three different ways, particularly at low frequencies. Assuming a free-edge cone, a straight-sided cone develops flower patterns as a result of nodes when viewed from the front under a stroboscopic light; an exponential cone develops nodes in an axial direction when viewed from the side; any cone develops transverse wave motion along the cone. These three phenomena are illustrated in Fig. 11.

Now for a given material of a specified thickness it does not require a great deal of imagination to see that the larger the cone in Fig. 11A, the more likely will there be an inherent tendency to develop nodes. Make up two cones of the same included angle with ordinary writing paper, one having a diameter of 3 inches and the other of 6 inches. You will find that the smaller cone is less easily deformed by pushing the free edge. This lesser rigidity at the edge can be counteracted by making the larger cone of thicker or stronger material or by making the included angle narrower (thus effectively reducing the diameter of the cone). Unfortunately, in a practical speaker, this has a detrimental effect on the performance because the heavier the cone the less response in the treble, and the narrower the cone the more intense is the focusing of the high notes. Even a flat diaphragm will not give uniform spherical radiation at all frequencies and a narrow angle cone produces a highly concentrated beam for all frequencies over about 1500 cps.

You may well ask, therefore, why not let the nodes form and stop worrying? The answer to this is that energy transmitted to the cone through the medium of the voice-coil is being used up to produce the nodes in the cone instead of pushing the air in front of the speaker, and so the response at the low frequencies will be reduced. A loudspeaker with linear response converts all the applied electrical energy into air (sound) waves; none is wasted in deforming parts of the speaker. The formation of nodes must be prevented, by making the diaphragm as rigid as possible.

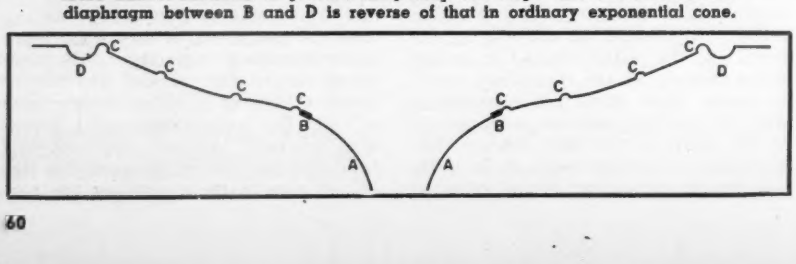
The first widely adopted method was to make the cone with an exponential cross-section as shown in Fig. 11B. Such a diaphragm is very rigid across a diameter, but now, as I have shown, the nodes develop in the direction of the axis of the cone. The flatter shape of the exponential diaphragm gives less focusing of the highs, but to stiffen it circumferentially, concentric corrugations are molded in the cone. Almost every speaker you examine will be found to have such corrugations incorporated in the diaphragm. But when we consider the case of Fig. 11C, a defect which has only recently been noted by some loudspeaker designers, the circumferential corrugations are no help at all, for they give no stiffness *along the material of the diaphragm.*

B. F. Miessner (in a letter published in *Radio-Electronics,* May 1954, pp. 134 *et seq.*) explains an ingenious solution for this difficulty by cementing soda straws to the cone, like spokes in a wheel. If too many are used, the mass of the diaphragm is unduly increased, and the method, from a commercial point of view, would be very costly. The deformation in a straightsided cone is not as great as in the flat area of an exponential cone, as you can imagine by thinking of the plane rigidity, if I may call it that, of a sheet of paper as compared with a cone; it occurred to me that if the flat part of the exponential cone could be abolished, a substantial improvement could be brought about. Experiment proved this to be the case. One solution to this problem, see Fig. 12, shows a cross-section of the diaphragm of my 215 speaker, in which the outer part of an ordinary exponential diaphragm has imparted to it a reverse curvature, so that the outer zone is itself reasonably rigid axially. Just before the flattest part the wave motion has been interrupted by the presence of points "B." The compliance (points "B") was not introduced specifically for this reason (its real purpose will be described later), but its presence does act as a barrier for the wave motion originating in the apex of the cone. What is transmitted beyond this point is neutralized by the curvature of the outer part of the diaphragm.

So far, then, it would seem that there are many snags attending the use of a large cone; why do so many loudspeaker manufacturers use them? Let us summarize these drawbacks; the large cone is heavier than a small one, so restricting the response at high frequencies; its mass is such that transient response is impaired because it is more difficult to start a heavy object moving rapidly than a light one; and its size makes it too flexible in various directions, thus causing loss of bass through energy being wasted in deforming the cone. Everything points to the use of a small cone, but the small cone has one fatal drawback —its power-handling capacity is very seriously limited.

Apart from the resistance to movement offered by the rear suspension spider and the front surround of the cone, that of the air in front of the diaphragm is substantial, as indeed it must be, since the function of the loudspeaker is to move air to create sound waves. It will be obvious that

Fig. 12. Cross-section of the Hartley 215 diaphragm. "AA" is the exponentially curved cone apex; "BB" the isolator consisting of a plastic compliance-junction. "CCCC" are the circumferentially molded ridges on cone. "DD" is a loose flannel surround to provide completely free edge. The curvature of the diaphragm between B and D is reverse of that in ordinary exponential cone.



a small cone will move less air than a large one, and the air resistance to the movement of a small cone is less than that of a large one. For a given input, therefore, the small cone moves forward more easily and has less output, and because it moves more easily it reaches its limit of movement, determined by the suspension system, sooner than in the case of a large cone. This is of importance only at the low frequencies, for the amount of movement for a given input depends on the frequency of the current applied to the voice-coil. This is why a large cone is said to be better for bass reproduction than a small one, but this only holds good for a given amount of displacement of the diaphragm. A small cone can move as much air as a large one provided it has greater freedom of movement.

Fig. 13 gives a series of curves for various sizes of cones plotted against distance to be moved and frequency, on the assumption that the speaker efficiency is constant and the input and output are also constant. Actually the curves were taken from measurements with speakers of about 5% efficiency (a not unusual figure for ordinary dynamic speakers) with an input of 5 watts; this would give an acoustic output of approximately 0.25 watt. It will be seen that to maintain constant output the movement required from a 5-inch cone rises very rapidly as the frequency approaches 30 cps, whereas with an 18-inch cone the increased movement required is very small. It will also be noticed that as soon as the cone size has increased beyond 8 inches, the advantages of increased power-handling and acoustic output is proportionately much less, for the curves crowd together as the cone size increases.

Despite the fact that these articles are concerned only with high-fidelity reproduction, I maintain that what happens below 40 cps doesn't matter very much. It is almost impossible to hear a 32-cycle note but it can be felt, and I believe that to attempt to create this "feeling" is a waste of time, money and effort. Even 50 cps is a very low note and quite a high proportion of high-fidelity installations cannot reproduce it without some sort of distortion; I am certainly content to have the lower limit of my frequency range at 40 cps but it must be free from distortion. I would rather have a limit of 50 cycles without distortion than one of 40 with some distortion.

At this lower limit, therefore, a study of the curves of Fig. 13 suggests that there is not much to be gained by having a cone larger than 10 inches, for you must remember the serious disadvantages of large cones from the point of view of treble reproduction, noding, and wave transmission along the cone itself. But you will still want to know why, in the face of this, speakers with cones from 12 inches to 15 inches are readily obtainable in any audio store. There can be no definite answer to this question. We do know that there are many individuals and speaker manufacturers who believe that a large speaker gives "better" bass reproduction than a small unit, so the bigger and more expensive your speaker the "better" the bass. Hand in hand with this argument is the one which states that it is well known that large cones have no treble, which is why the best systems are multi-channel jobs, where a tweeter looks after the highs while the woofer looks after the lows.

Both these arguments are completely specious. The large speaker will certainly give *more* bass than the small one, but its larger output has more distortion, owing to noding and wave transmission. There is the further disadvantage that the air partially enclosed by the large cone has a resonant frequency at a point which can seriously impair the reproduction by imposing a one note hoot on the whole sound coming from the loudspeaker. This you can test for yourself. Place one ear right inside the cone of the speaker and tap the cone with your fingernail. You will hear at least one low sound which is caused by the resonant frequency of the suspension. Now grip the cone-coil joint with two fingers while you tap the cone with a fingernail of the other hand and you will hear another note of higher frequency than the previous one. This is caused by the reaction of the paper of the cone on the air within it and causes the hoot I have mentioned. It is avoided by taking care that the air within the cone is not even partially enclosed, best achieved by making the cone as flat as possible, but not so flat that it allows axial nodes to develop easily, and obviously still more certainly achieved by making the cone small.

If you have a pair of musically trained ears and are listening for distortionless musical reproduction, if your ears have not been preconditioned by long bouts of listening to sound reproducers, hi-fi or otherwise, you will hear this hooting effect with any large diaphragm speaker. It has nothing whatever to do with the bass resonant frequency, it is a necessary acoustic accompaniment of a large cone. The nearest equivalent to it in the instruments of the orchestra is found in the drums, which emit sounds at the resonant frequency of the stretched skins, but have an accompaniment in the resonance of the air inside. This effect I sardonically christened many years ago as "the characteristic sound of a loudspeaker" and there seems to be absolutely no cure but that of using smaller cones of the correct design. The question of power handling is answered by using two smallish speakers instead of one large one, perhaps a superficially clumsy way of doing it, but there is great merit in using two speakers widely spaced for they give an extremely good imitation of binaural reproduction.

Finally, we come to the question of the cone. On the face of it nothing need be said on this point as all diaphragms seem to be made of paper pulp treated with some sort of dope or varnish; but as in the next article we shall meet tweeters with metallic diaphragms, it seems desirable to point out that the material of which the diaphragm is made has a bearing on the sound emitted by the speaker, independent of frequency response. This must happen with speakers as it happens with musical instruments, the woodwinds of the orchestra sound different from the brass, the wooden pipes of the organ different from the metal pipes. These musical tubes are not diaphragms, but they are part of a vibrating system which includes air, as is the diaphragm of a loudspeaker. Speaking very crudely it might be said that wooden pipes sound "tubby" and metal pipes sound "tinny" or shrill; this seems so obvious that it is hardly worth saying, yet the obvious is sometimes overlooked in designing loudspeakers.

The cone should be acoustically inert, it should impose no coloration of its own. It is my considered opinion that the cone should be made of a very high grade Bakelite resin, containing not more than 10% of rag tissue as a binder. To make such a cone in quantities by molding is an almost impossible manufacturing proposition, owing to the danger of the molds sticking; but cones can be fabricated out of flat sheets of this material. Unfortunately only straight-sided cones can be made

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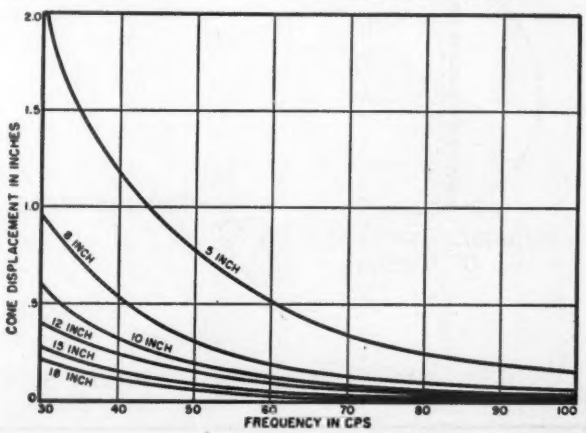

Fig. 13. Movement required of the various sizes of diaphragms at low frequencies to avoid bass distortion. Speaker efficiency is about 5%. Audio input is 5 watts.

A New Single-Gun Color Tube

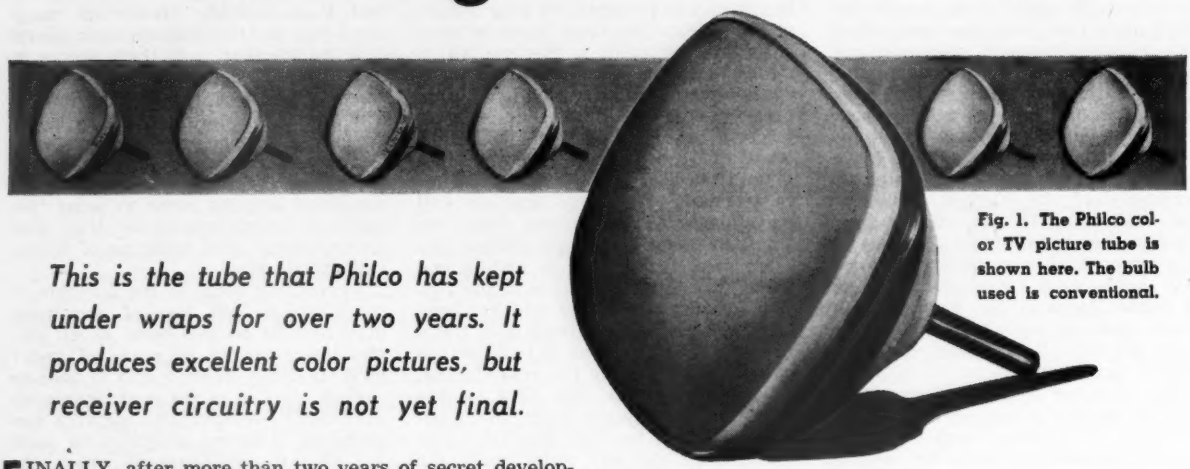

Fig. 1. The Philco color TV picture tube is shown here. The bulb used is conventional.

This is the tube that Philco has kept under wraps for over two years. It produces excellent color pictures, but receiver circuitry is not yet final.

FINALLY, after more than two years of secret development, the *Philco Corporation* has divulged the principles of operation and the extent of development already accomplished on its "Apple" color TV system. At the same time, the company released information on the single-gun color tube it developed to go with this color TV system. The word "Apple" has been used by *Philco* as a code name for this system, which has been one of the best kept secrets in the electronics industry.

Basically, the tube uses a single electron gun to excite the vertical color phosphor stripes on the face plate. Instead of directing the beam to a particular color stripe in a regular switching and deflecting sequence, as the *Lawrence* single-gun tube does, the "Apple" tube allows the beam to sweep across the face of the tube as in monochrome practice but the modulating information to the beam is switched according to the position of the beam. In other words, as the beam passes over a red stripe the red signal is passed to the gun. The same holds true for blue and green. Such a principle requires an indexing system to provide information concerning the whereabouts of the writing beam and a modulating system to provide the required beam modulation.

The "Apple" color picture tube, shown in Fig. 1, may be generally described as an all-glass 21" rectangular picture tube providing 260 square inches of useful screen area, having a diagonal deflection angle of 74°, and using magnetic focusing and deflection. The color television display system described here requires a picture tube that must satisfy certain specific and unusual requirements. These are:

1. Small spot size
2. Two electron beams that "track" each other and have a minimum of "crosstalk"
3. A screen consisting of a repeating pattern of vertical red, blue, and green luminescing phosphors arranged in lines in a precisely described fashion on the face of the tube
4. A secondary emission index-producing structure as an integral part of the screen

The two fundamental parts of the "Apple" system are "sequential writing" and "electrical index." The expression "sequential writing" means that the beam passes successively over triplets of fine vertical red, green, and blue stripes, as shown in Fig. 2. A particular color is produced by modulating the beam during the time it is passing over each triplet according to the proportions of primaries in the desired color.

The expression "electrical index" refers to a signal derived from the anode of the "Apple" tube itself that continuously gives information on the location of the beam. The beam current responds to two types of instructions: the color video signal from the transmitter and the index signal.

The index signal is obtained from the tube by means of the structure shown in the insert in Fig. 2. A line, called the index stripe, of a material having high secondary emission compared to the aluminized background of the tube face, is placed behind every red line. A second beam, the "pilot" beam, parallel to the writing beam, is produced

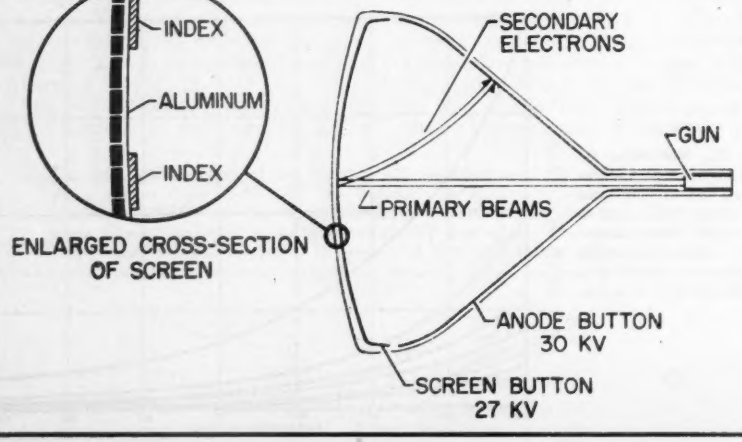

Fig. 2. Top cross-sectional view of the "Apple" color TV tube showing the path of the electron beam from the gun, and the path of the secondary electrons which are knocked off the screen and collected.

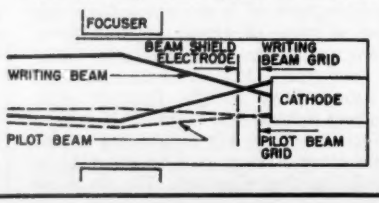

Fig. 3. Method of producing two electron beams in a single electron gun. Note the co-planar grids, one for each beam. Both beams, one for writing the picture on the screen and the other for indexing, must track perfectly if the system is to work.

at the gun and sweeps the index stripes in company with the writing beam. The secondary emission current produced as the "pilot" beam crosses these index stripes is collected and amplified, resulting finally in a signal at the same frequency as that at which the writing beam must be varied to produce colors.

The "pilot" beam is so aligned that it always strikes the same color line as the picture writing beam. However, the beams must be kept separate to avoid intermodulation between the "pilot" carrier and writing frequency signal.

The luminescent screen or anode of the "Apple" tube consists of a repeating array of red, blue, and green vertical stripes as mentioned previously. The stripes are not contiguous but have a 50% duty cycle; that is, the spaces between the lines are as wide as the phosphor lines themselves. The spaces between the lines are filled in with guard bands made of a dark-colored, non-luminescent material which improves color saturation and enhances contrast under normal ambient light by reducing the reflectivity of the screen. Correct white balance is built into the screen of the "Apple" tube by adjusting the relative efficiencies of the blue and green phosphors through the addition of varying amounts of non-activated material so that scanning of the screen with a constant, unmodulated beam produces white.

Among the important advantages of the "Apple" tube is its similarity to a black-and-white tube. In fact, in the absence of a chrominance signal, it cannot help making a good black-and-white picture. None of the writing beam in the "Apple" tube is intercepted nor deflected in such a way as to waste any high voltage power, and there is no problem of matching the characteristics of three guns to obtain good colorimetry.

The color saturation obtainable at any particular brightness level is obviously limited by the spot size at the beam current associated with that brightness. If the spot is too large to land on one primary color stripe at a time, then de-saturation of primary colors occurs. This consideration, plus that of reasonable structural resolution, made the development of an electron gun producing a spot substantially smaller than usual in a monochrome tube, a prime necessity for this beam-indexing tube.

A combination of a small, countersunk aperture and close cathode-to-grid spacing is primarily responsible for obtaining a greatly reduced spot size.

A second requirement is that the two beams "track" each other. Since one beam is used to tell where the other beam is, the relative position of the beams must be known at all times. The two beams are formed close together by using a single cathode, and two separate, co-planer, control grids, each with its aperture close to the end of the grid, these ends being separated by .002 inch. The center-to-center separation of the two beams at the grid plane is only .029 inch. See Fig. 3. This setup assures good "tracking," since both beams are so close together that they will be acted upon in exactly the same amount by deflecting fields, etc.

The third special requirement of this beam-indexing tube arises from the need for preventing the control voltage of one beam from affecting the intensity or position of the other beam. This is satisfied by using a simple shield between the two beams in the region just above the grid apertures. This shield, shown in Fig. 3, effectively eliminates beam "crosstalk" as a limitation on the functioning of the system.

The final unique feature of the *Philco* beam-indexing color tube is the index structure which provides the required continuous monitoring signal. This signal is generated by the difference in secondary emission between an array of magnesium oxide stripes applied to the gun side of the aluminized screen and the bare aluminum between these stripes. There are two contact buttons on one side of the tube envelope (see Fig. 5), and one of these is connected to the screen aluminum coating, making it possible to maintain the screen potential at approximately 27 kilovolts. The second contact button connects to the bulb coating which is maintained at 30 kilovolts. The three kilovolt differential between screen and bulb coating results in the collection of the secondary electrons from the screen by the bulb coating.

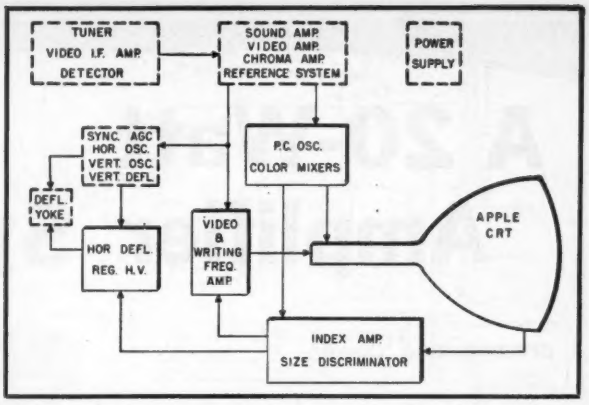

Fig. 4. Block diagram of developmental color TV set using single-gun color tube described in this article. The circuits enclosed in the solid boxes are peculiar to the "Apple" system.

To obtain the indexing signal, an external band of a conductive coating encircles the screen viewing area to form a coupling to the screen aluminum film. A metal mounting band is strapped over this coating and is used to support the tube and yoke-focuser cup in a manner similar to monochrome receiver practice. The mounting feet, which support the assembly in the cabinet, are insulated from the metal mounting band but are grounded to the foil shield. The circuit elements formed by the band, the aluminized screen to which it is coupled, and ground, are tuned to resonance at the index sideband frequency. Index signal take-off is accomplished by a coaxial lead connected to the mounting band. To shield the index circuit from external interference, an aluminum foil shield is folded to cover the rim of the CRT. The tube and circuitry do not appear sufficiently sensitive to magnetic fields to require any magnetic shielding or compensation for earth field effects.

Fig. 4 is a block diagram of the circuitry of the receiver shown in Fig. 5. This is one version of a complete "Apple" receiver. The circuits shown in the light dashed lines follow conventional color receiver practice and the "Apple" receiver imposes no special requirements here. The re-

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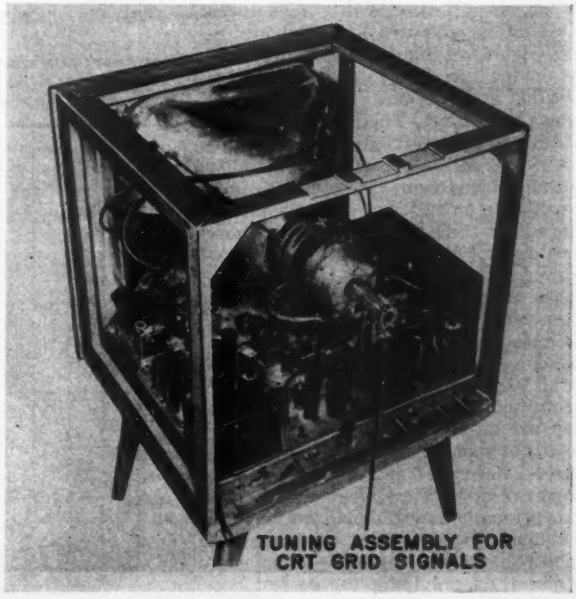
Fig. 5. Inside view of Philco developmental color TV receiver based upon beam-indexing principle and using "Apple" tube.



A 20-Watt Amplifier System

A preamp and power amplifier with six inputs, tone controls, and loudness control—all on a single chassis.

Over-all view of the Eico 20-watt unit. The controls, from left to right, are: the selector switch, level, loudness, brass, and treble controls.

FOR those who have been looking for a well-engineered yet inexpensive power amplifier, the newly-released *Eico* Model HF20 unit might offer a simple solution to their problem. Not only does this unit provide 20 watts of power but the circuit incorporates a preamplifier and a variety of controls on a single chassis.

Of the "Ultra-Linear" Williamson type, this compact (8½" high, 15" wide, and 10" deep) circuit provides up to 34 watts peak power. Frequency response is +0, —1 db from 13 to 35,000 cps at ¼ watt with power response at 20 watts +0, —1 db from 20 to 20,000 cps.

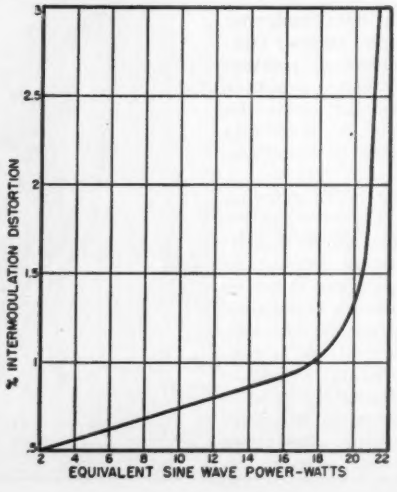
The circuit incorporates four high-level inputs and two low-level inputs. The high-level inputs will handle a TV set, tape recorder, AM-FM tuner, crystal and ceramic cartridges, or other equipment. The low-level inputs handle ceramic cartridges (with adapters) or FM and magnetic pickups, without component changes. A low-impedance output jack is conveniently placed for the accommodation of those owning or planning to buy a tape recorder.

There are five phono equalizer positions which can be selected by means of a rotary switch: RIAA, *Columbia, London,* European 78's, and American 78's. Bass can be boosted or cut 15 db at 50 cps, while the treble can be boosted or cut 15 db at 10 kc. Two separate controls provide this feature. These bass and treble tone controls are of the new feedback type for exceptionally low distortion and wide frequency range. They do not affect the volume or interact with each other, thus providing the easiest possible control settings. Since the turnover on both ends varies with the amount of boost and attenuation, boost or cut at the extremes of the audio range is possible without affecting the mid-range.

The loudness control circuit is a *Centralab* "Compentrol" which raises and lowers the volume in strict accordance with the Fletcher-Munson response curves.

The IM distortion of the amplifier (60 to 6000 cps mixed 4:1 at 20 watts) is 1.3% while the mid-band harmonic distortion at 20 watts is .3%. The damping factor is 7:1 and the inverse feedback 14 db. Taps are provided for 4, 8, and 16 ohm speakers.

Equivalent sine wave power plotted against the per-cent of intermodulation distortion for the Eico 20-watt power amplifier.



Sensitivity is .004 volt r.m.s. (at 1000 cycles) for 20-watt output with magnetic phono pickups and .4 volt r.m.s. for 20-watt output with the tuner and other accessory units.

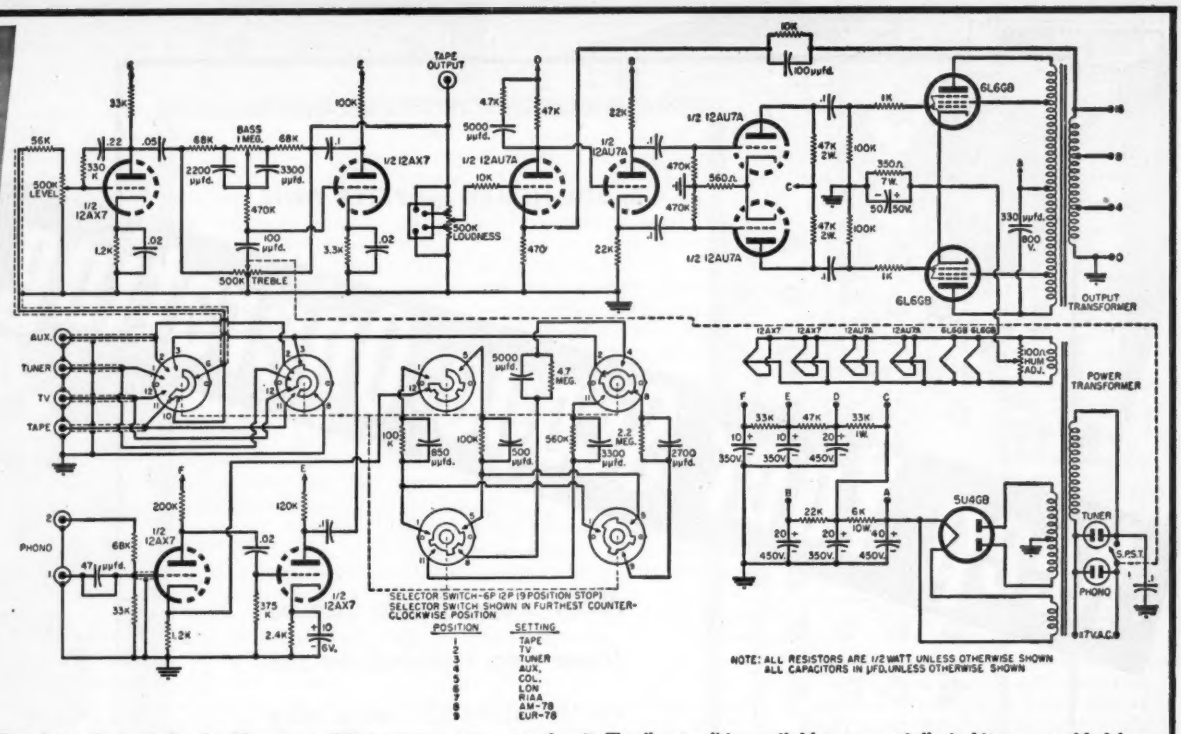
Hum and noise is —60 db below 20 watts with magnetic pickups (including the 16 db boost at 60 cps due to RIAA compensation) and —75 db below 20 watts with the tuner, etc. Both of these figures were obtained with maximum gain and the tone controls set at the "flat" positions.

The HF20 will operate at either 50 or 60 cycles and voltages from 105 to 125 volts. The unit draws 100 watts.

The amplifier uses seven tubes: two 12AX7's, two 12AU7A's, one 5U4GB, and a pair of 6L6GB's in push-pull. If desired the output tubes can be replaced by 6L6GA's or the metal 6L6's or, if the builder chooses, the premium 5881's can be used. No circuit changes are required with these tube substitutions but the tubes must be matched to insure minimum distortion.

Circuit Description

The circuit employed in the HF20 is fairly straightforward and conventional in design. The two low-level phono inputs are applied to a 12AX7

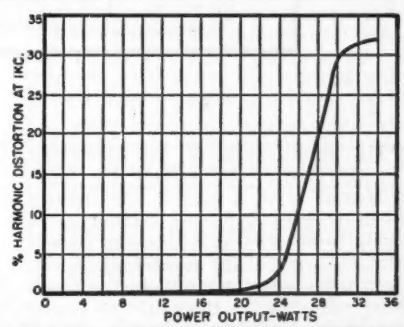


Complete schematic for the 20-watt amplifier, preamp, tone-control unit. The "system" is available commercially in kit or assembled form.

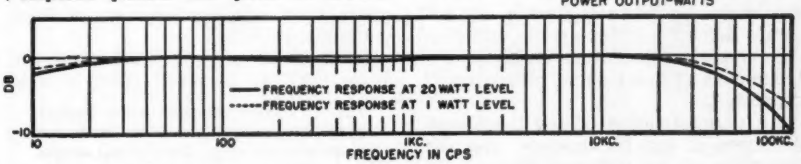
equalizer-preamplifier whose response characteristics are determined by the setting of the selector switch. Note that a jumper is wired across the 47 µµfd. input coupling capacitor from phono terminal 1. This jumper is clipped open when it is desired to use a *Weathers* FM capacitance pickup without the *Weathers* adapter. With such an adapter, this pickup is connected to terminal 2 and the jumper is left intact. Note also that the selector switch not only determines the equalization but also connects the proper input terminal to the unit. Output from the equalizer circuit or directly from the four high-impedance inputs is then applied through the level control to a second 12AX7 preamplifier circuit incorporating bass and treble controls. The output of this stage is then fed through the loudness control to a 12AU7A, operating as direct-coupled, low-level voltage amplifiers. The second section of this tube is a phase-splitter which feeds equal amplitude but opposite polarity signal voltages to another 12AU7A, the driver amplifier. Outputs from this driver are then applied to the grids of the 6L6GB push-pull power amplifiers whose screen grids are connected to taps on the output transformer to provide "Ultra-Linear" operation. Degenerative feedback is taken from the secondary winding of the output transformer and is applied to the cathode of the first section of the 12AU7 low-level voltage amplifier.

The HF20 is being offered in two forms, as a kit at $49.95 and completely wired at $79.95. —30—

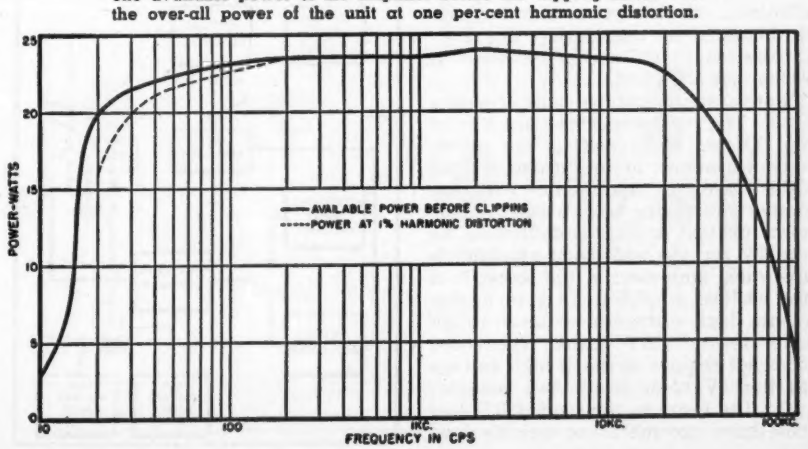
Harmonic distortion at 1000 cps versus the power output of amplifier (in watts).

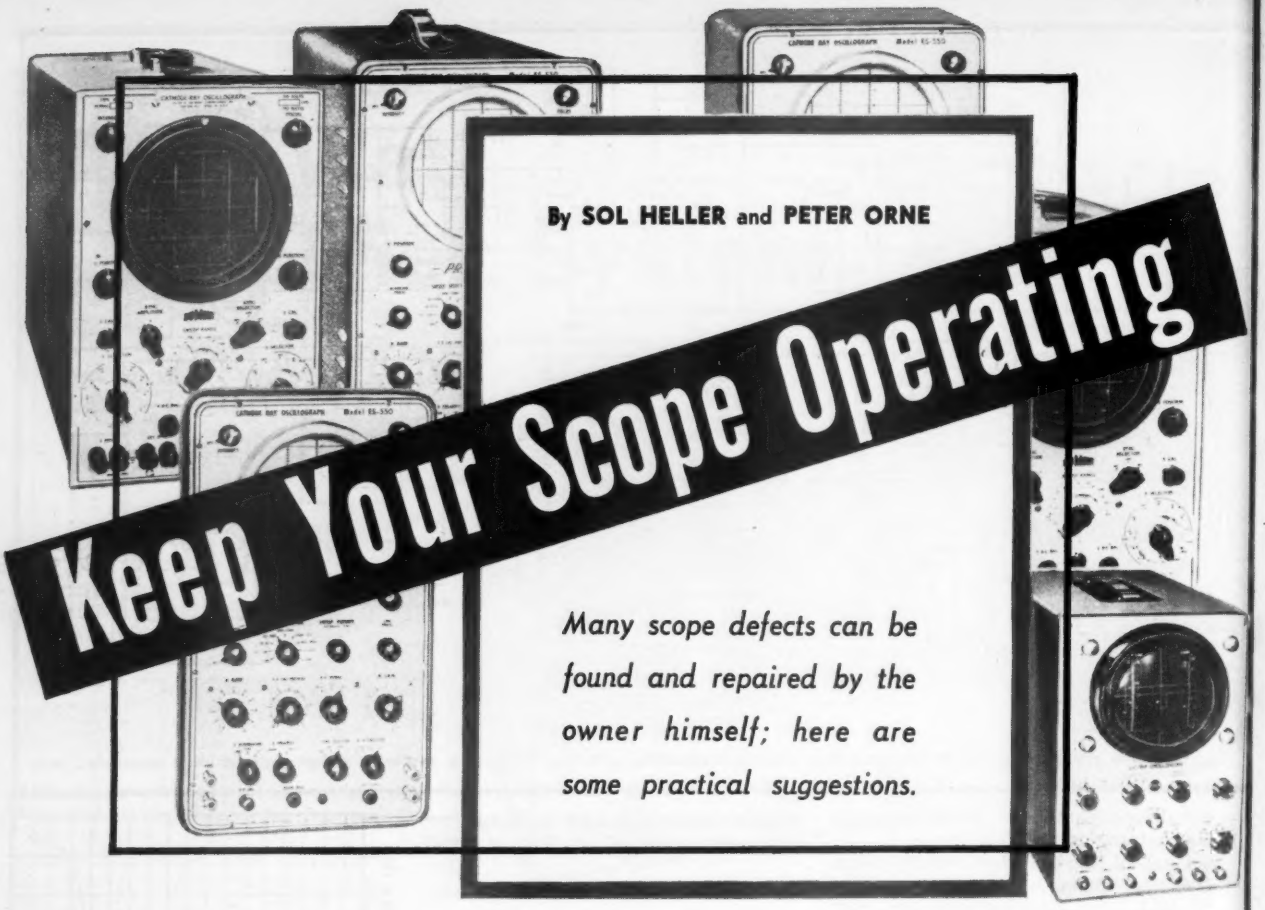


Over-all frequency response of the amplifier at 1 and 20 watt levels from 10 cps out to 100,000 cps. The details on this response pattern are given in article.



The available power of the amplifier before the clipping action and the over-all power of the unit at one per-cent harmonic distortion.





Keep Your Scope Operating

By SOL HELLER and PETER ORNE

Many scope defects can be found and repaired by the owner himself; here are some practical suggestions.

THE oscilloscope is the electronic right arm of the modern TV technician. If it is sent to the factory when it goes bad, the technician is likely to be separated from an important service tool for several weeks. To keep those waveforms cycling without interruption, it is desirable to repair the scope immediately when it becomes defective. This article will provide enough information to enable the technician to make such "on the spot" repairs.

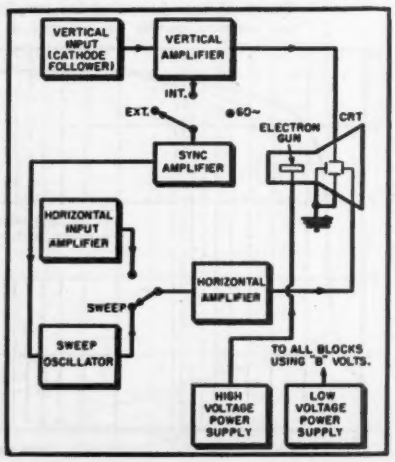
An understanding of the basic construction of the oscilloscope, and the functions of its different sections, is necessary if repairs are to be made efficiently. Such an understanding can be obtained by considering the similarities—and differences—between a scope and a TV set.

Both instruments are built around a CRT. The most important function of the TV set is to display the necessary variations in brightness on the CRT screen in conjunction with the proper sweep; the scope's most important function is vertical deflection. In the TV set, the wide-band amplifier is the video amplifier; in the scope, it is the vertical amplifier. In both instruments, high voltage is required to accelerate the CRT beam. The scope does not require as much high voltage as the TV receiver for two reasons:

1. The beam in the scope CRT does not have to move as quickly and therefore does not have to be as intense as the beam in the TV receiver CRT. The TV receiver beam covers the entire screen in 1/30 of a second; the beam in the scope, on the other hand, traces one waveform or series of waveforms continuously. The illumination of the scope screen is adequate with a lower amount of high voltage present.

2. A hood can be used over the scope CRT to shield it from outside light. The screen illumination and high voltage requirements are reduced to some extent for this reason.

Fig. 1. Block diagram of a typical service-type oscilloscope showing the basic sections only. Specialized scopes often have more elaborate circuitry.



The size of the scanning spot on the scope CRT is larger than it is on a TV receiver CRT due to the smaller amount of high voltage used in the scope; a larger spot is, however, tolerable in the scope.

In the TV set, the video signal is applied between the CRT grid and cathode. These electrodes are generally kept near ground potential. In the scope, the signal is fed to the vertical deflection plates, and sometimes also to the horizontal deflecting plates. These scope electrodes will therefore be found near ground potential. However, the 2nd anode of the scope CRT must be at the same potential as the deflection plates, to avoid the defocusing that would take place if this requirement were not met. This necessitates the application of a high negative voltage to the cathode of the scope CRT. (In the TV CRT, a high positive voltage is applied to the 2nd anode.) A still more negative voltage must be applied to the control grid of the scope CRT, to provide the proper bias.

A final important difference between a scope and a TV set is that the scope generally uses an electrostatically deflected CRT, while the TV receiver commonly uses a magnetically deflected one. The reason for this is that the yoke required for magnetic deflec-

tion of a scope CRT would have to permit a current to flow that was proportional to the input signal, to produce a faithful replica of the input signal waveshape on the screen. This is rather difficult and expensive to achieve (scopes using magnetic deflection have, however, been built). In an electrostatic deflection system, no such problem exists; deflection plates are fed by sweep voltage amplifiers, and such amplifiers can readily be designed to reproduce the signal waveshape with adequate fidelity. The capacitance between each set of deflection plates distorts the signal waveshape to some extent, but the effect can readily be compensated.

The block diagram of a representative scope is shown in Fig. 1. The functions of the different sections should, by now, be self-evident to the technician. A representative oscilloscope circuit is reproduced in Fig. 2.

Servicing Procedures

When power is applied to the scope, various controls are manipulated—chiefly brightness, focus, and centering—to obtain a visible scanning spot on the CRT screen. If no spot can be obtained, the fault may lie in one of the controls just referred to, the power supply, or the CRT. To locate the defect, proceed as follows:

Turn the brightness control all the way up and carefully examine the screen. If a faint glow is visible at the edge of the screen, centering trouble is present. The glow referred to is produced by stray electrons; such electrons are not affected by the centering voltages and will thus cause a glow to be visible even when these voltages are improper. If the glow is *not* visible, turn the brightness control from high to low setting and back. If a faint glow is present, varying its brightness will make it more discernible. If the procedure just outlined causes the glow to become visible but the scanning spot cannot be made to appear, look for trouble in the centering circuits.

In many scopes with push-pull vertical deflection, the output tubes are direct coupled to the CRT deflection plates; varying the bias of these tubes (by means of potentiometer adjustment) provides centering. If one of the push-pull amplifier tubes is defective, centering will not be possible. Look for a defect of this kind, when centering trouble is present in such a scope.

In some oscilloscopes, the output tubes are single-ended; that is, the vertical and horizontal amplifiers each feed one deflection plate, while the opposite plate is grounded. A potentiometer in the circuit associated with one deflection plate (of each pair) varies the d.c. voltage present between both plates, and thus permits centering adjustments (see Fig. 3). If centering is absent or improper in a scope of this kind, look for a defect in the centering potentiometers, or in some resistor in the voltage divider circuit associated with each potentiometer.

If the service technician suspects that trouble exists in a centering circuit, but is uncertain whether this is actually the case, the following test will help him reach a decision:

Short the deflection plates to each other (horizontal to horizontal and vertical to vertical) at the terminals on the scope where provisions have been made for applying signals directly to the plates (see Figs. 4A, 4B, and 4C). (Most scopes have such provisions to permit a signal to be applied directly to the deflection plates, rather than through the scope amplifiers; the latter may distort certain types of signals.) If a spot can now be obtained, trouble in the centering circuits is definitely indicated.

If no scanning spot is seen on the CRT screen, and the centering system has been given a clean bill of health, the voltages at the CRT socket should be checked. Keep in mind that high voltages, negative with respect to ground, are present at the CRT socket. Treat this part of the scope with respect, since it is capable of dealing out dangerous shocks. The high voltage in an oscilloscope is derived from a half-wave rectifier circuit which is fed line voltage that has been stepped up by a transformer. This type of "brute force" supply is generally capable of delivering lethal currents, so be careful.

The voltages that may normally be expected at the CRT socket are as follows:

The cathode is generally about 2000 volts negative with respect to ground. In some scopes, the cathode-to-ground voltage is less, and may even be as little as −700 volts. The control grid is normally between 0 and 80 volts

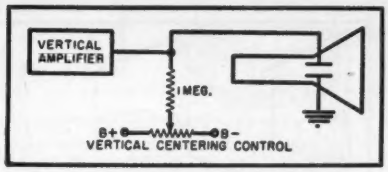


Fig. 3. Simplified schematic diagram of one type centering control circuit.

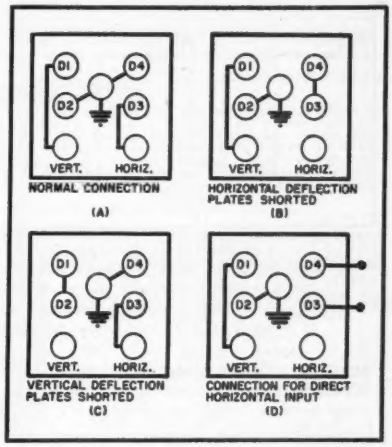
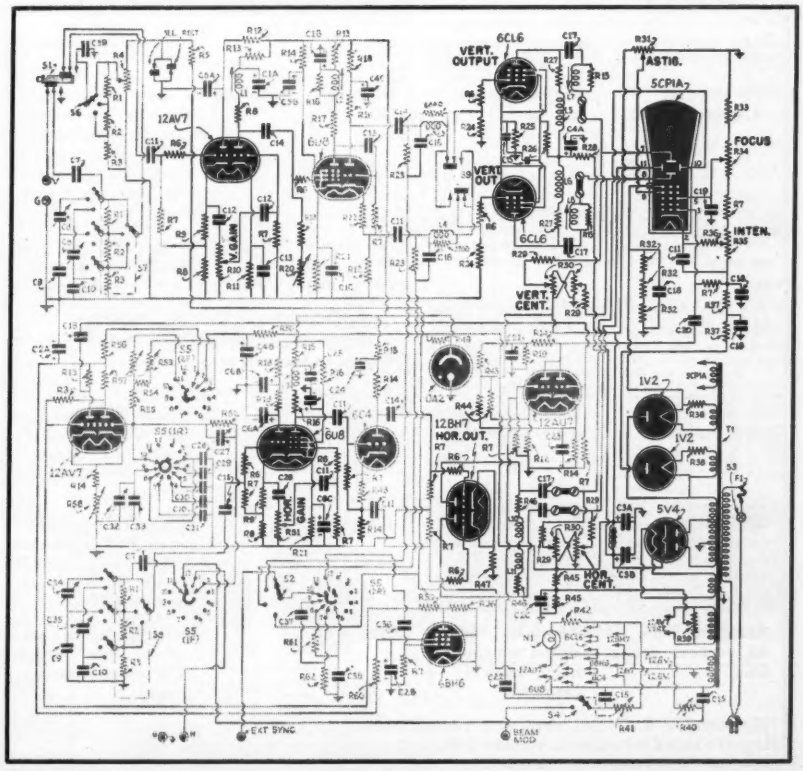


Fig. 4. Most oscilloscopes contain terminals at the rear or on the side for direct connection of an external signal to the deflection plates as shown.

Fig. 2. Schematic diagram of a typical general-purpose oscilloscope using push-pull deflection. Note highlighted sections. This is the Precision ES-550.



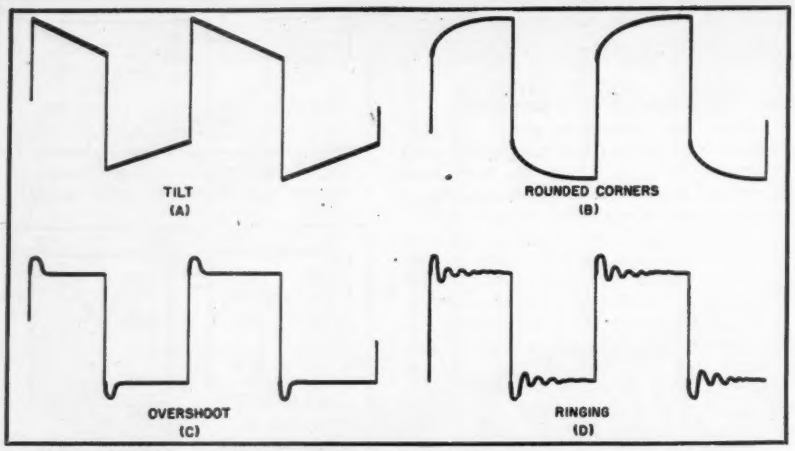


Fig. 5. Effect of a defective vertical amplifier on a square-wave signal fed into the scope from a square-wave generator. If the vertical amplifier has poor low-frequency response, the scope will reproduce the square wave as shown in (A); poor high-frequency response is shown in (B). (C) and (D) are the result of excessive high-frequency response of the oscilloscope's vertical amplifier.

negative with respect to the cathode, depending on the setting of the brightness control. The focus anode voltage varies from one scope to another. It should generally be one-fifth to one-third the value of the high voltage present in the scope.

An accelerating anode (in addition to the 2nd anode) is used in the scope CRT to speed up the beam. In less expensive scopes, this anode may be found connected to the 2nd anode, with both anodes grounded. Or, both anodes may be connected to "B+" to provide a little more accelerating voltage. In other scopes, the accelerating anode voltage is made variable; the potentiometer used to vary it is called an "astigmatism" or "spot shape" control, since its adjustment affects the roundness and sharpness of the scanning spot. The "astigmatism" control generally permits a voltage varying from 0 to 200 volts to be applied to the accelerating anode.

Finally, there is the CRT heater voltage. This is standardized at 6.3 volts in all modern oscilloscope CRT tubes.

For proper operation of the scope, normal voltages must be present at the CRT. Use a suitable voltmeter, or voltmeter-probe combination, to measure the high voltage. Exercise due caution in making this measurement. If the CRT voltages are normal, and no scanning spot can be obtained, the CRT is defective. If the voltage between any electrode and ground is incorrect, the circuit components associated with that electrode should be checked. The electrodes connect to simple voltage dividers in the power supply; such circuits are relatively easy to troubleshoot. If no high voltage is present, the high-voltage rectifier or power transformer may be defective, or a filter capacitor may be bad.

Table 1. Review of the testing procedure outlined in the text for troubleshooting defective oscilloscopes. Be certain to refer to the manufacturer's schematic.

SYMPTOM	TEST	NORMAL TEST RESULT	DEFECTIVE SECTION
Dead scope, pilot light off.			Power supply; fuse.
Pilot light on, no trace or light.	Turn brightness full up.	Glow on screen of CRT.	If there is no glow check the low or high voltage power supply or CRT. If there is a glow, see symptom, "No trace, glow present."
No trace, no glow.	CRT voltages.	2nd anode: 0 to "B+." Focus anode: −200 to −1000 v. Cathode: −700 to −2000 v. Grid-to-cathode: 0 to −80 v.	If the voltages are incorrect, check the power supply. If voltages are correct, check the CRT.
No trace, glow present.	Short the deflection plates.*	Spot on screen.	If there is no spot visible, check the CRT. If the spot appears, check the centering circuit.
Centered spot, no horizontal line.	Apply a.c. test signal to horizontal input.	Horizontal line.	If no line is present, check horizontal amplifier. If line appears check the horizontal sweep oscillator.
Horizontal line, no vertical deflection.	Apply a.c. test signal to points along vertical amplifier.	Sine wave.	Defective stage precedes point where sine wave first appears.

*Horizontal to horizontal, vertical to vertical plate.
Note: Voltages indicated in column 3 depend on particular scope under test.

No Sweep

If a spot is seen on the CRT, but no horizontal sweep is obtainable, that is, a horizontal line cannot be produced on the screen by suitable manipulation of the scope controls, the trouble lies in the CRT, horizontal sweep oscillator, or horizontal sweep amplifier. The trouble can be further localized by switching off the scope horizontal oscillator (through suitable adjustment of one of the scope controls) and applying an a.c. test signal to the horizontal input terminals. Such a signal is generally available at the front panel of the scope. If a horizontal line of some kind now becomes visible, trouble in the horizontal sweep oscillator is indicated. If the test signal does not produce any visible output, the trouble probably lies in the horizontal amplifier. A defect in the CRT may also be responsible for the symptoms.

To determine which of these possible sources of trouble is present, apply a test signal directly to the CRT horizontal deflection plates (after first disconnecting the plates from the amplifier circuit, as indicated in Fig. 4D). If a horizontal line is now seen, the horizontal amplifier is defective; if there is no horizontal line, the trouble is in the CRT. It should be noted that in some scopes, the horizontal oscillator and amplifier are contained in the same tube; a defect in such a tube may make the horizontal sweep oscillator and amplifier stages simultaneously inoperative.

If a defect in the horizontal amplifier stage is indicated by the preceding test, try a new horizontal amplifier tube first. When several stages are present in the horizontal section, the scope itself may be used to locate the circuit point at which the signal is lost. One of the two procedures to be described may be employed for such troubleshooting (it is assumed that there is no horizontal sweep and tube replacement tests have not revealed the defect):

1. Feed a 60 cps test signal to the

(*Continued on page* 116)

only LAFAYETTE can do it!

SAVE 33 1/3-50%

PROFESSIONAL TRANSCRIPTION TURNTABLE AND VISCOUS-DAMPED TONE ARM

THE FINEST TRANSCRIPTION TURNTABLE AND TONE ARM FOR THE PROFESSIONAL USER AND THE AUDIOPHILE

PK-100 TRANSCRIPTION TURNTABLE

New 3-speed instrument to delight the connoisseur, is precision engineered to provide dynamic balance and "wow-free" operation. A heavy-duty, constant speed 4-pole induction motor has a variable speed control to permit instant adjustment of the individual speeds to within ± 7% to compensate for power source voltage variations. The motor is freely suspended and isolated by shock-mountings to eliminate vibration transferral. The heavy, cast aluminum turntable is rim-driven and has an extra-heavy rim for smooth, effective flywheel action. Idler disengaged in "off" position. Meets professional standards for wow, flutter content, etc. Size: 13½" x 14" and requires 2¾" clearance above and 3¾" below motorboard. For 110-130V 60/50 cycle AC. Supplied with removable 3-speed stroboscopic disc and 45 rpm adapter. Handsome hammertone gray finish. Shpg. wt., 20 lbs.

PK-100 ..... Net **49.50**

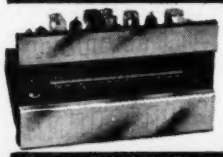
PK-90 VISCOUS-DAMPED TONE ARM

This transcription arm assures dependable and stable operation, utilizing the "floating action" principle of "viscous-damping." The arm is supported at a single point by a pivot and jewel bearing having negligible friction. Damping is accomplished by a silicone fluid occupying the gap between a ball and socket. This damping control permits high compliance and negligible tracking error, and prevents damage to either record or stylus should the tone arm be accidently dropped. Low frequency resonance, skidding and groove-jumping are likewise minimized. The tone arm accepts all records up to 16" and accommodates virtually all hi-fi cartridges by means of precisely engineered adapters which simplify installation and provide proper stylus pressure.

This tone arm is a quality companion to the PK-100 with matching finish. Shpg. wt., 2½ lbs.

PK-90 ..... Net **19.50**

FM-AM TUNER KIT



Basic FM-AM Tuner having outstanding specifications and delivering astonishing performance — all at a budget price in easily assembled kit form.

- AFC DEFEAT CIRCUIT WITH FRONT PANEL CONTROL
- FOSTER-SEELEY DISCRIMINATOR CIRCUIT
- GROUNDED GRID TRIODE AMPLIFIER
- 20-20,000 CPS RESPONSE

Choose this 7 tube compact high-fidelity FM-AM tuner whose characteristic features are found in units costing many times as much, and whose performance is unheard of at this low price. There are two front panel controls, a function control for AM, FM, PHONO, TV and a tuning/AFC defeat control. Features Armstrong FM circuit with limiter and Foster-Seeley discriminator. Simplified tuning with slide-rule dial and flywheel counterweighted mechanism, high impedance phono input and high impedance audio output.

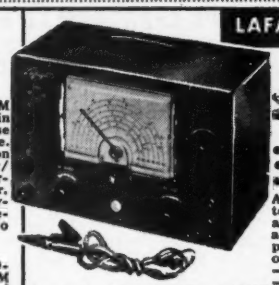
SPECIFICATIONS

FREQUENCY RANGE: FM, 88-108MC, AM, 530-1650 KC. **ANTENNA INPUT:** FM, 300 ohms, AM Ferrite loopstick and high impedance external antenna. **DISTORTION:** Less than 1% at rated output. **FREQUENCY RESPONSE:** FM, ± .5 db 20 to 20,000 cps, AM ± 3 db 20 to 5000 cps. **SENSITIVITY:** FM, 5 UV for 30 db quieting, AM, Loop sensitivity 80 UV/meter. **SELECTIVITY:** FM, 200 KC bandwidth, 6 db down; 375 KC FM discriminator peak to peak separation, AM, 8 KC bandwidth, 6 db down. **IMAGE REJECTION:** 30 db minimum. **HUM LEVEL:** 60 db below 100% modulation: **TUBE COMPLEMENT:** 2-12AT7, 1-6BE6, 1-6BA6, 2-6AU6, 1-6AL5 plus selenium rectifier. **SIZE:** 5¼" high x 9⅝" wide x 9½" deep (excluding knobs). **CONSUMPTION:** 30 watts. For 110-120V 60 cycles AC. Attractive etched copper-plated and lacquered finish. Less metal case. Shpg. wt., 9 lbs.

KT-100 ..... NET **32.50**

ML-100....Metal cage for above, Shpg. wt., 3 lbs. **5.00**

LAFAYETTE SIGNAL GENERATOR



NEVER BEFORE HAS A COMPLETELY WIRED AND TESTED INSTRUMENT OF SUCH ACCURACY AND QUALITY BEEN OFFERED AT SUCH A PRICE!

- FREQUENCY 120 KC TO 260 MC
- 120 KC TO 130 MC ON FUNDAMENTALS
- LABORATORY ACCURACY AND QUALITY

A completely wired and tested instrument not to be confused with units sold in kit form at almost the same price, but with a quality and accuracy of instruments 3 to 4 times its price. Six overlapping ranges generate signals of 120KC — 320KC, 320KC — 1000KC, 1MC — 3.2MC — 11MC, 11MC — 38MC and 37MC — 130MC all on fundamentals with calibrated harmonics from 120MC to 260MC. Selector switch gives instant choice of ranges. Switch gives choice of internal modulation of 400 CPS or use of any external source at other frequencies. For audio testing the 400 cycle signal can be used separately. Outputs are unmodulated RF, modulated RF and 400 CPS audio. RF output is in excess of 100,000 microvolts and jacks are provided for choice of either high or low RF output. Stability is insured by special circuit design. Has a fine adjustment RF control. AF output is 2-3 volts, AF input is 4 volts across 1 megohm. Large clear 5 inch etched dial plate and pointer are protected by transparent plastic bezel. Common AF terminals for EXT-MOD input and INT-AF for audio tests eliminate need for special AF output connectors. Machine engraved panel lettering. Handsome gray metal case with carrying handle. Measures 6½" x 10" x 4½". Comes complete with pair of leads. AC line cord and plug. Operates on 105-125V 50-60 cycle AC. Shpg. wt., 8 lbs.

LAFAYETTE LSG-10 SIGNAL GENERATOR **22.50**

SLIM HIGH OUTPUT DYNAMIC MICROPHONE

Reg. Price 11.50

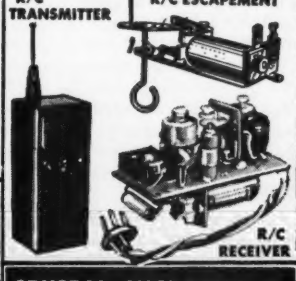
9.95

A pencil-slim design, high output PA Dynamic Microphone of exceptional quality, at a price that is ⅓ of the price of any comparable microphone on the market today. Very smooth response, 60-10,000 cycles. Omnidirectional, tiltable head. Switch on side gives choice of either high impedance (50,000 ohms) or low impedance (250 ohms). Instantly removable bracket permits use either on stand or as hand mike. Features exceptional mechanical strength. Cast case with satin chrome finish, ⅝"-27 thread. Acoustically-treated grille head, 3" long; 1¼" barrel diameter. Shipping weight 2 lbs.

PA-29.....In lots of 3, Each **9.25**
Singly, Each **9.95**

R/C RECEIVER AND TRANSMITTER

RANGE OF APPROXIMATELY 1 MILE



R/C Receiver is completely assembled and wired, with tube and ready to operate on exam-free 27.255 MC remote control band. Size: 1⅝" x 1-15/16" x 3". Wt. 3.3 oz. Requires one 1.5 volt and one 45 volt battery.

F-208 ..... Net **7.95**

R/C Transmitter is completely assembled, tested and guaranteed, and includes tube and 27.255 MC crystal. 6 section telescoping antenna. Size: 4" x 4" x 12". Less batteries. Shpg. wt. 3 lbs.

F-249 ..... Net **19.95**

TRANSMITTER 1 Burgess, 2D or RCA VS069 Net. Ea. **.45**

BATTERIES: 2 Burgess XX45 or RCA VS016 .....Net. Ea. **2.28**

R/C Escapement is completely wired, sturdy and self-neutralizing. Weighs ½ oz. Low current drain. Size: 1⅛" L x ½" W. Shpg. wt. 5 oz.

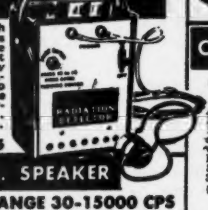
F-194 ..... Net **2.45**

SPECIAL COMBINATION OFFER

Consists of R/C Transmitter (F-249), R/C Receiver (F-208) and Escapement (F-194). All three at a super special price.

F-250 ..... Net **28.95**

LAFAYETTE GEIGER COUNTER KIT WITH HIGH SENSITIVITY VICTOREEN TUBE 1B85



Lafayette Geiger Counter Kit with High Sensitivity Victoreen 1B85 tube, makes this one of the most outstanding kit buys in the country. This tube is used only in the most expensive equipment. Easy to build, at only a fraction of the price, of commercial instruments of this type. Just turn it on, flip the high voltage switch and listen to the clicks. Kit includes all parts, tube, carrying case, 22½" and 1½" volt Batteries. Complete instructions for quick assembly. Shpg. wt., 1½ lbs.

KT-75.....Net **14.95**

CRYSTAL MICROPHONE

COMPARE IT WITH ANY MIKE AT 2 TO 3 TIMES THE PRICE

A quality crystal Microphone for PA systems, house recorders, etc. Frequency response 30 to 10,000 cycles. Output level —53 db. Provides ample output for use with low gain amplifiers. Complete with 8 ft. of shielded cable. Shpg. wt., 3½ lbs.

PA-24— in lots of 3, each .. **3.95**
singly, each **4.25**

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All have coated lenses — clamped in prisms — light weight all metal bodies. Complete with case and straps.

F-102 —	6x.15	I.F....	NET 10.75
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F-123 —	7x.35	C.F....	NET 20.95
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F-117 —	10x.35	C.F....	NET 23.95
F-104 —	12x.50	I.F....	NET 27.95
F-118 —	12x.50	C.F....	NET 27.95
F-125 —	20x.50	C.F....	NET 37.95

Add 10% Fed. Tax to Above Prices

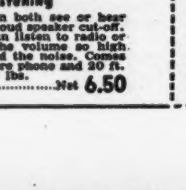
IMPORTED 12 HI-FI COAX. SPEAKER

Reg. Price 44.50 Net **29.50**

- FREQUENCY RANGE 30-15000 CPS
- HANDLES 20 WATTS OF POWER
- COMPLETE WITH LEVEL CONTROL
- POWERFUL TSK-5 MAGNETS
- SPECIAL SHEEPSKIN-EDGED CONE

A Lafayette exclusive import and exceptional value. Consists of a 12" woofer, coaxially mounted 2½" tweeter and a built-in crossover network. The specially processed fibre cone has a sheepskin edge to suppress unwanted modal vibrations and insure beautiful tone quality. Highly efficient TSK-5 magnets. Level control provides variation to 6 db cut. Maximum input 20 watts. Impedance 8 ohms. Rugged all-metal frame. If made in this country, would cost at least $49.50. Shpg. wt., 11 lbs.

SK-58 ..... Net **29.50**



- For Hard-of-Hearing
- For Late Listening

One or two people can both see or hear the program with the loud speaker cut-off. The hard-of-hearing can listen to radio or TV without turning the volume so high that others can't stand the noise. Comes complete with miniature phone and 20 ft. of cable. Shpg. wt. 3 lbs.

MS-129 ..... Net **6.50**

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Mac's Service Shop

By JOHN T. FRYE

TECHNICIAN'S APPROACH TO HAM PROBLEMS

IT WAS a blistering hot July day outside, but the interior of Mac's Service Shop was a cool and dry seventy-five degrees, thanks to the new air conditioning units that had just been installed in both the front office and the service department.

"You know, Mac, it's a real joy to return to work here on a hot day like this," Barney remarked. "I could hardly wait to get back after lunch. That sun's a real scorcher today."

"I'm glad to hear you say that," Mac, his employer, replied. "I've been noticing how prompt you are recently, and I'm beginning to hope the extra work I'll get out of you may help pay for the air conditioning."

"I know this installation set you back plenty, but in my book it's worth it," Barney said earnestly.

"In all seriousness, I'm sure it is," Mac agreed. "First, it creates a favorable impression on the customers who come into the shop. Secondly, Amanda is patient and courteous with them because she is comfortable and at ease; and you and I do much better work, too, because we are comfortable. When sweat is running down your arms and dripping off the end of your nose into the chassis on which you are working, it is doggoned hard to be alert for every symptom of something not quite right. There is every temptation to let things slide a bit and to finish off the job as quickly as possible. That's just human nature."

"You're so right. I was wishing last night that our radio club meeting was air conditioned. I had to give a talk; and between nervousness and the sticky weather, I was sweating like a hoe handle."

"What did you talk about?"

"The title was 'A Professional Technician's Approach to Ham Problems.' In case you're wondering, *I* am the professional technician—and please keep any remarks about same to yourself."

"I have no remarks," Mac denied blandly. "You *are* a professional technician, and a darned good one. To admit otherwise would be to impugn my ability as a teacher—and we can't have that, can we?"

"I'll have to think that over a bit before I can decide whether I've been complimented or insulted. At any rate, I feel I'm well prepared to talk on this subject because I've worked both sides of the street. I can well remember the blundering hit-and-miss methods I used to employ in trying to run down trouble in my ham equipment, and I also know how comparatively easy it is for me to locate and straighten out these difficulties now. Yet practically the whole difference lies in how I went at the job before and how I tackle it after doing TV service work for a few years."

"Sounds interesting," Mac remarked. "Tell me more."

"Remember you asked for it," Barney warned with a pleased grin. "I started out by saying any technician worth his salt realized he had to have a certain minimum amount of service equipment to do a good job. At the same time I well understand from my own experience that the average ham has only a limited amount of money to spend on his hobby and he prefers to allot all he can to improving the 'productive' ether-busting quality of his signal rather than investing in 'nonproductive' test equipment."

"That figures."

"Then I went on to say I thought the best investment for a ham was a 20,000 ohms-per-volt v.o.m. If he likes, he can select one of several excellent instruments of this kind on the market; or, if he prefers, he can buy one in kit form and put it together himself."

"Why not a v.t.v.m.?"

"I was hoping you'd ask that," Barney said complacently. "There are several good reasons. First, a v.t.v.m. is likely to be affected by the strong r.f. fields around a transmitter and give erratic unreliable readings when the rig is on. Secondly, the v.o.m. is self-contained and independent of the power lines. It can be used just as easily for checking the mobile rig in the trunk of the car as for use with the transmitter in the shack. Finally, most v.t.v.m.'s do not have provision for reading currents; and being able to read currents accurately is quite important around a transmitter."

"You overlooked one more argument: generally speaking a v.o.m. retains its calibration better than does a v.t.v.m. because of the different principles on which the two operate. This becomes important when a person has only one general-purpose meter and must depend upon what it tells him without being able to check it easily against other meters. The ham who has a good v.o.m. in his shack and takes care of it will have a standard on which he can depend year after year."

"That *is* a good point, and I should have thought of it. Your saying something about 'taking care of the meter' reminds me I brought that up, too. I passed along that little trick you taught me of always automatically returning the meter selector switch to the '1000 volts d.c.' position as soon as I finished making a measurement. That way, if you forget to reset the switch to the proper scale before socking the test prods across high voltage—and this is *so* easy to do—no damage will be done.

"I went on to say that it was a good idea when making checks on a transmitter always to check first with the meter in the 1000 volts d.c. position before setting the function-scale switch to a scale you think should be adequate. Things can happen in a rig that will produce unusual voltages at unexpected places. If you happen to try to check the resistance at one of these points, the meter pointer will probably end up looking like a hair spring. Testing for any possible voltage before going to the 'ohms' scale will obviously prevent this disaster."

"What else did you tell the boys?"

"I talked about how important it was to have an accurate and up-to-date diagram of the equipment around the ham shack. I explained that we had around five hundred dollars tied up in nothing but diagrams of the receivers on which we worked and that we were adding to this constantly, for we know how much easier it is to troubleshoot with a diagram. I urged that diagrams of the receivers, transmitters, and test equipment all be kept conveniently together. If the transmitter is home-brew, a very careful diagram should be drawn up. Whenever any change is made in any of the equipment, that change should be carefully and immediately noted on the diagram."

"That certainly makes a lot of sense."

"Next I told how much better it is to use 'dynamic' testing methods rather than the 'static' kind. I explained that we always try to put a receiver into some kind of operating condition as soon as possible because it is much easier to spot trouble in a live set than in one not turned on. In the latter case, all you can do is check each component separately until you finally stumble on one that is bad—if you're lucky enough to have trouble that will reveal itself in this kind of test. On the other hand, with the equipment working, a defective part will usually produce several symptoms, such as changes in voltage or current, overheating of parts, oscil-

lation, etc., that will point accusing fingers right at the defective unit. Dynamic testing is particularly effective and easy with transmitters because the signal handled is of robust, easily-measured proportions. A crystal r.f. probe used with the v.o.m. will detect the presence of r.f. at low intensity points, such as grids; and the old reliable, cheaply-built absorption type wavemeter will show the presence and frequency of this r.f. in the plate tank circuits.

"This, of course, led directly into the subject of dummy antennas, I said flatly that in my book a dummy antenna was the first piece of test equipment any ham ought to build, since he could do this easily by selecting the proper number and wattage of incandescent lamps and connecting them in series, parallel, or series-parallel arrangement to present the proper impedance load to the transmitter while absorbing its normal output. Using such a device a ham can troubleshoot his transmitter to his heart's content without disturbing fellow amateurs. A defective transmitter has no more place on the crowded ham bands today than a defective automobile has on our crowded highways."

"That's advice apparently some of them could use. I still hear fellows on the air with lousy signals asking others to diagnose their trouble and tell them how to fix it."

"I know, and that's about as sensible as going around asking your neighbors for medical advice when you're sick. Anyone who has listened even casually to one of these 'round-table clinics' quickly decides that what one ham terms a good signal another calls terrible. Each one, since he has no reliable observed data to go on, comes up with a different suggestion based on his own narrow experience. Nine times out of ten, trying to find your trouble that way is just a waste of time and a nuisance."

"How did you wind the talk up?"

"I tried to explain that troubleshooting is composed of roughly these steps: First, you gather all the symptoms you can from observation, voltage and current checks, listening on the monitor, and so on. Then, keeping all these symptoms in mind, you study the diagram and try to imagine a component failure that could produce all the symptoms. Having decided on such a component, you test it individually or replace it with a unit known to be good and see if that clears up the trouble. If not, you replace the original part and look for another likely suspect. It is important that you change only one part at a time so that when and if you do cure the trouble you will know what was causing it. Changing parts in a helter-skelter manner may easily contribute new troubles to those with which you started.

"As a finale I gave an example of what I meant. Suppose I receive a report my modulation is distorted. Immediately I pull the transmitter off

(*Continued on page* 129)

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Next time you replace paper tubulars, make sure you use these new Mallory capacitors. They give you a lot of extra value features—without extra cost.
Soldering iron heat can't loosen leads. Wires are permanently attached in the plastic end seal . . . can't work loose from heating or vibration.
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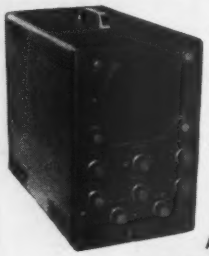
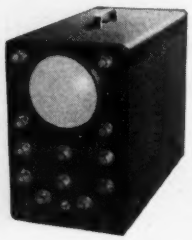
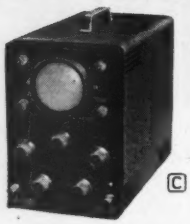


Ⓐ MODEL O-10



Ⓑ MODEL OM-1



Ⓒ MODEL OL-1

MODEL MM-1
VOM

MODEL M-1
HANDITESTER

MODEL V-7A
VTVM

Ⓐ *Heathkit* **ETCHED CIRCUIT** COLOR TV

5" OSCILLOSCOPE KIT

Amplifier response essentially flat (+2 db −5 db) from 5 mc down to 2 cps without extra switching. Sweep oscillator allows single-cycle observation up to 500,000 cps, and will sync signals even higher. Uses etched metal circuit boards. Push-pull vertical and horizontal amplifiers—built in peak-to-peak calibrating source—step attenuated input—preformed and cabled wiring harness. A professional scope ideal for color TV work in the lab or service shop. 11-tube circuit features 5UP1 CRT.

MODEL O-10
$69.50
Shpg. Wt. 21 Lbs.

Ⓑ *Heathkit* **ETCHED CIRCUIT**

5" OSCILLOSCOPE KIT

The OM-1 has many big scope features, including 5", 5BP1 cathode ray tube, and yet it is priced reasonably. Features etched metal circuit boards. Incorporates 3 step input attenuator—phasing control—built-in peak-to-peak voltage calibrator—and push-pull vertical and horizontal amplifiers. Vertical amplifier flat within ±3 db from 2 cps to 200 kc. Sweep circuit functions from 20 cps to 100,000 cps. An excellent general purpose scope for service shop or lab.

MODEL OM-1
$49.50
Shpg. Wt. 21 Lbs.

Ⓒ *Heathkit* **ETCHED CIRCUIT**

3" OSCILLOSCOPE KIT

Has many of the features of the Model OM-1, yet is smaller in physical size for portability, and for use in the home workshop. Employs etched metal circuit boards. Vertical frequency response within ±3 db from 2 cps to 200 kc. Sweep generator operates from 20 to 100,000 cps. The 8-tube circuit features a type 3GP1 cathode ray tube. Measures only 9½" h. x 6½" w. x 11¾" d.

MODEL OL-1
$29.50
Shpg. Wt. 14 Lbs.

Heathkit **20,000 OHMS/VOLT**

VOM KIT

Requires no external power. Sensitivity is 20,000 ohms/v. DC and 5,000 ohms/v. AC. Black Bakelite case—4½" 50 ua. meter—1% precision resistors. AC and DC ranges are 0-1.5 5, 50, 150, 500, 1500, and 5000 volts. Direct current ranges are 0-150 ua., 15 ma., 150 ma., 500 ma., and 15 a. Resistance multipliers are X1, X100, and X10,000. DB range from −10 db to +65 db. Especially valuable in portable applications.

MODEL MM-1
$29.50
Shpg. Wt. 6 Lbs.

Heathkit **HANDITESTER KIT**

This compact model easily slips into tool box, glove compartment, or coat pocket. Valuable as "extra" instrument in service shop, and ideal for the home experimenter. Very popular with appliance repairmen, and electricians. Measures AC or DC voltage at 0-10, 30, 300, 100, and 5000 volts. Direct current ranges are 0-10 ma., and 0-100 ma. Attractive black Bakelite case.

MODEL M-1
$14.50
Shpg. Wt. 3 Lbs.

Heathkit **ETCHED CIRCUIT VACUUM TUBE**

VOLTMETER KIT

The V-7A is used in scientific laboratories, technical schools, service shops, ham shacks, and in the home workshop. Features 200 ua. meter, 1% precision resistors, and etched metal circuit board. Measures DC voltage, ACV (rms), AVC (peak-to-peak), and resistance. AC (rms) and DC voltage ranges are 0-1.5, 5, 15, 50, 150, 500, and 1500 volts. Peak-to-peak ranges are 4, 14, 40, 140. 400, 1400, and 4000 volts. Ohmmeter ranges provide multipliers of X1, X10, X100, X1000, X10K, X100K, and X 1 megohm. DB scale also provided. 11 megohm input impedance.

MODEL V-7A
$24.50
Shpg. Wt. 7 Lbs.

NEW *Heathkit* **PROFESSIONAL RADIATION COUNTER KIT**

- *Modern circuit design for maximum sensitivity and reliability.*
- *Employs 900 volt Bismuth tube in beta/gamma sensitive probe.*
- *Both visual and aural indicators for radiation level.*

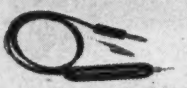
This radiation counter features ranges of 0-100, 600, 6000, and 60,000 counts per minute and 0-.02, .1, 1, and 10 milliroentgens per hour. The probe uses a 6306 Bismuth tube. The 5-tube circuit employs a 4½", 200 ua. meter, calibrated in cpm, and mR/hr. Also aural signal provided from panel-mounted speaker. Simple to build from the instructions supplied, even for a beginner.

MODEL RC-1
$79.95
Shpg. Wt. 8 Lbs.

HEATH COMPANY A Subsidiary of Daystrom, Inc **BENTON HARBOR 15, MICH.**

Heathkit
PROBE KITS

ETCHED CIRCUIT RF
No. 309-C. **$3.50**
Shpg. Wt. 1 Lb.
Use with any 11 megohm VTVM for RF measurements up to 250 mc with ±10% accuracy. Employs etched circuit.



ETCHED CIRCUIT PEAK-TO-PEAK
No. 338-C. **$5.50**
Shpg. Wt. 2 Lbs.
Use to read peak-to-peak voltages on DC scale of 11-megohm VTVM. Read direct on VTVM scales from 5 kc to 5 mc.

30,000 VOLT D.C. HIGH VOLTAGE
No. 336. **$4.50**
Shpg. Wt. 2 Lbs.
Use to measure high DC voltage with VTVM. Precision multiplier resistor mounted inside plastic probe. Multiplication factor of 100 on Heathkit 11-megohm VTVM.

PROBES FOR VTVM

PROBES FOR SCOPE

LOW CAPACITY
No. 342. **$3.50**
Shpg. Wt. 1 Lb.
Low capacity probe prevents circuit loading. Features variable capacitor for correct impedance matching. Ratio of attenuation can be controlled.

SCOPE DEMODULATOR
No. 337-C. **$3.50**
Shpg. Wt. 1 Lb.
This probe functions like detector to pass only modulation of signal, and not signal itself. Applied voltage limits are 30 volts rms, and 500 VDC.

Heathkit ELECTRONIC SWITCH KIT

This instrument allows simultaneous oscilloscope observation of two input signals by producing both signals, alternately, at its output. All-electronic circuit provides 4 switching rates, selected by panel switch. Provides gain for input signals, and features frequency response of ±1 db 0-100 kc. Employs seven miniature tubes. Sync output provided to control scope sweep. Functions at signal levels as low as 0.1 volt.

MODEL S-3
$21.95
Shpg. Wt. 8 Lbs.

Heathkit VARIABLE VOLTAGE REGULATED POWER SUPPLY KIT

This power supply provides regulated DC output that can be manually controlled from 0 to 500 volts. Supplies up to 130 ma at 200 VDC, and up to 10 ma at 450 VDC. Large panel meter monitors output voltage or current. Supplies filament voltage at 6.3 volts AC (4 amperes). Filament and B+ circuits isolated from ground. Ideal lab power supply for use in experimental work.

MODEL PS-3
$35.50
Shpg. Wt. 17 Lbs.

Heathkit ISOLATION TRANSFORMER KIT

Provides isolation between the power line and equipment under test. No direct connection between primary and secondary. Keeps chassis of AC-DC sets "cold." Fused in the primary circuit. Also provides manual voltage control from 90 volts to 130 volts for test purposes. Rated at 100 volt-amperes continuously. Panel meter monitors output voltage.

MODEL IT-1
$16.50
Shpg. Wt. 9 Lbs.

Heathkit DIRECT READING CAPACITY METER KIT

This unique instrument indicates capacity in mmf, or mfd, directly on a 4½" 50 ua. meter. Ranges are 0 to 100 mmf, 0-1000 mmf, 0-.01 mfd, and 0-.1 mfd. Residual capacity less than 1 mmf. Scales are linear. Instrument not susceptible to hand capacity effects. Will measure even small value trimmers or variable air capacitors.

MODEL CM-1
$29.50
Shpg. Wt. 7 Lbs.

Heathkit VIBRATOR TESTER KIT

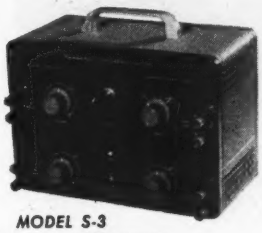
Checks condition of vibrators under operating conditions. Tests 6-volt vibrators only. Use in conjunction with BE-4 battery eliminator, or similar variable power source. Indicates vibrator quality on large "good-bad" scale. Tests both interrupter and self-rectifier types. 5 different sockets.

MODEL VT-1
$14.50
Shpg. Wt. 6 Lbs.

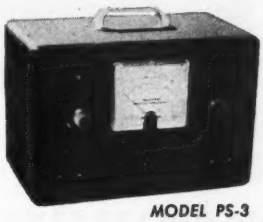
Photographers! *Heathkit* ENLARGER TIMER KIT

Use to time photographic enlarger. "Time" dial allows settings of from 5 to 60 seconds. Will also control safe-light "on" when enlarger is "off." Enlarger and safelight plug into recepticals on front panel. Handles up to 350 watts. Ideal device to free operator for other operations, and very simple to build. Compact plastic case.

MODEL ET-1
$11.50
Shpg. Wt. 3 Lbs.



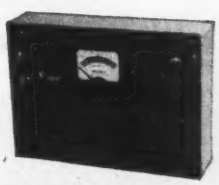
MODEL S-3
ELECTRONIC SWITCH KIT



MODEL PS-3
VARIABLE VOLTAGE REGULATED POWER SUPPLY KIT

MODEL IT-1
ISOLATION TRANSFORMER KIT

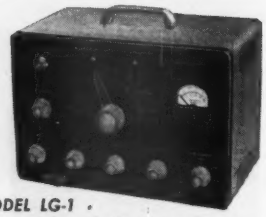
MODEL CM-1
CAPACITY METER KIT



MODEL VT-1
VIBRATOR TESTER KIT

HEATH COMPANY A Subsidiary of Daystrom, Inc. **BENTON HARBOR 15, MICH.**

MODEL TS-4
TV SWEEP GENERATOR KIT



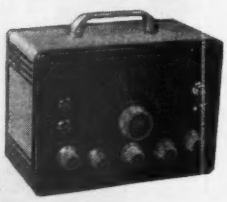
MODEL LG-1
LABORATORY GENERATOR KIT

HEATHKIT®

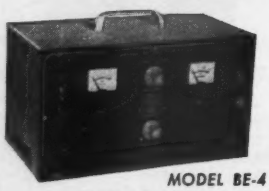
instruments

CONTAIN HIGH QUALITY COMPONENTS THROUGHOUT. EACH AN OUTSTANDING DOLLAR VALUE IN TEST EQUIPMENT.

MODEL LP-2
LINEARITY PATTERN
GENERATOR KIT



MODEL
SG-8
RF SIGNAL
GENERATOR
KIT



MODEL BE-4
6-12 VOLT BATTERY ELIMINATOR
KIT

Heathkit TV SWEEP GENERATOR KIT

All-electronic sweep circuit eliminates mechanical hum and vibration. Features improved linearity—effective AGC—flat output—0 to 40 mc sweep. Covers all frequencies for black and white or color TV work, as well as FM. High output for alignment of tuners, IF strips, boosters, etc. Fundamental output from 4 to 220 mc in four bands. Has crystal oscillator (4.5 mc and multiples thereof), and variable marker covering 19 to 60 mc—up to 180 mc on harmonics. Provision for external marker. Effective two-way blanking.

MODEL TS-4
$49.50*
Shpg. Wt. 16 Lbs.

Heathkit LABORATORY GENERATOR KIT

This signal generator covers from 100 kc to 30 mc on fundamentals in 5 bands. 400 cycle modulation variable from 0 to 50%. RF output up to 100,000 microvolts. Meter reads RF output or percentage of modulation. Fixed step and variable output attenuation. Voltage regulation, double copper-plated shielding for stability, and other "extras." Provision for external modulation. Output impedance 50 ohms.

MODEL LG-1
$39.50*
Shpg. Wt. 16 Lbs.

Heathkit LINEARITY PATTERN GENERATOR KIT

Supplies information for white dots, cross-hatch pattern, horizontal bar pattern, or vertical bar pattern. Use for adjustment of vertical and horizontal linearity, picture size, aspect ratio, and focus. Dot pattern is a *must* for color convergence adjustments. Clip merely connects to antenna terminals of TV set. Panel provision for external sync if desired. Covers channels 2 to 13. 5 to 6 vert. bars and 4 to 5 hor. bars.

MODEL LP-2
$22.50*
Shpg. Wt. 7 Lbs.

Heathkit SIGNAL GENERATOR KIT

This tried and proven generator covers 160 kc to 110 mc on fundamentals in five bands, and calibrated harmonics extend to 220 mc. Very popular in service shops, laboratories, and home workshops. RF output is in excess of 100,000 microvolts, controlled by a variable and a fixed-step attenuator. Output is pure RF, RF modulated at 400 cps, or 400 cps audio for amplifier testing.

MODEL SG-8
$19.50*
Shpg. Wt. 8 Lbs.

Heathkit BATTERY ELIMINATOR KIT 6-12 volt

This up-to-date battery eliminator will supply either 6 or 12-volt output to take care of auto radios from even the most modern automobiles. Output voltage is variable 0-8 volts DC or 0-16 volts DC. Will deliver up to 15 amperes at 6 volts or up to 7 amperes at 12 volts. Two 10,000 microfarad output filter capacitors insure smooth DC output. Panel meters monitor output current. Will double as a battery charger. Definitely required for automobile radio service work.

MODEL BE-4
$31.50*
Shpg. Wt. 17 Lbs.

Heathkit CONDENSER CHECKER KIT

Measures paper, mica, ceramic, and electrolytic capacitors in 4 ranges from .00001 to 1,000 microfarads. Indicates condenser value and quality. Also measures resistance from 100 ohms to 5 megohms. All values indicated directly on panel scale, after adjusting for null on electron beam "eye" tube. No calculations necessary. A valuable instrument in service or laboratory applications.

MODEL C-3
$19.50*
Shpg. Wt. 7 Lbs.

Heathkit SUBSTITUTION BOX KITS

Model CS-1 **$5.50*** Shpg. Wt. 2 Lbs.

This unit provides switch selection of capacitor values from .001 mfd. to .22 mfd, in 18 RTMA standard values. Kit includes 18" flexible leads with alligator clips.

Model RS-1 **$5.50*** Shpg. Wt. 2 Lbs.

Provides switch selection of resistances from 15 ohms to 10 megohms, in 36 RTMA values. Resistors are 1 watt, 10%. Extremely valuable in all types of electronic activity.

HEATH COMPANY A Subsidiary of Daystrom, Inc **BENTON HARBOR 15, MICH.**

Heathkit "Q" METER KIT

The model QM-1 measures the Q of inductances and the RF resistance and distributed capacity of coils. Employs a 4½" 50 microampere meter for direct indication. Features built-in signal source for tests at frequencies of 150 kc to 18 mc in four ranges. Measures capacity from 40 mmf to 450 mmf within ±3 mmf. Indispensable for coil winding, and determining unknown capacitor values. A worthwhile addition to the laboratory or ham shack at a very low price.

MODEL QM-1
$44.50
Shpg. Wt. 14 Lbs.

Heathkit DECADE RESISTANCE KIT

Provides 20 1% precision resistors that are switched to provide values from 1 to 99,999 ohms, in 1-ohm steps. High quality components for precision lab work.

MODEL DR-1
$19.50
Shpg. Wt. 4 Lbs.

Heathkit DECADE CONDENSER KIT

Employs high precision 1% silver-mica capacitors for switch selection of values from 100 mmf to 0.111 mfd. in steps of 100 mmf. Employs ceramic switches for reduced leakage. Invaluable in the laboratory.

MODEL DC-1
$16.50
Shpg. Wt. 3 Lbs.

Heathkit IMPEDANCE BRIDGE KIT

This bridge features built-in oscillator and amplifier. Measures resistance, capacitance, inductance, dissipation factors of condensers, and storage factor of inductance. D, Q, and DQ functions combined in one control. Employs ½% resistors and ½% silver-mica capacitors. 100-0-100 ua. meter indicates null. Two-section CRL dial provides ten separate "units" with accuracy of .5%. Fractions of units read on variable control.

MODEL IB-2
$59.50
Shpg. Wt. 12 Lbs.

Heathkit TUBE CHECKER KIT

You can afford your own tube tester, even if you are an experimenter, or only do part time service work. Uses a 4½" meter with 3-color meter face for simple "good-bad" indications of tube quality, on the basis of emission. Will test all tubes commonly encountered in radio and TV service work. 14 different filament voltage values provided. Built-in roll chart—ten 3 position lever switches for open or short tests on each tube element. Space provided for future socket addition.

MODEL TC-2
$29.50
Shpg. Wt. 12 Lbs.

Heathkit PORTABLE TUBE CHECKER KIT

The Model TC-2P is identical to the Model TC-2 except that it is housed in a rugged carrying case. This two-tone case is finished in proxylin impregnated fabric. The cover is detachable, and the hardware is brass plated. Ideal for home service calls.

MODEL TC-2P
$34.50
Shpg. Wt. 15 Lbs.

MODEL 355
Shpg. Wt. 1 Lb.
$4.50

Heathkit TV PICTURE TUBE TESTER ADAPTER

Use with TC-2. Tests picture tubes for emission and shorts. 12-pin socket, 4 ft. cable, octal connector, and technical data. Not a kit.

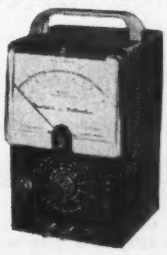
Heathkit CATHODE RAY TUBE CHECKER KIT

Indicates condition of CRT on large "good-bad" scale. Spring-loaded switches protect operator. Checks all electro-magnetic deflection picture tubes normally encountered in TV servicing. Housed in portable case for service calls. Supplies all operating potentials. Tests for shorts, leakage, and emission. Checks tubes on the work bench, in the carton, or in the set. Features shadowgraph test (spot of light on the screen).

MODEL CC-1
$22.50
Shpg. Wt. 10 Lbs.

Heathkit AC VACUUM TUBE VOLTMETER KIT

Here is a VTVM designed especially for audio work. Combines high impedance, wide frequency range, and high sensitivity. Frequency response, substantially flat from 10 cps to 50 kc. Sensitivity allows measurements as low as 1 mv at high impedance. Ranges are .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 volts rms. Total db range −52 to +52 db. 1 megohm input impedance at 1 kc.

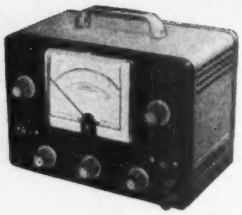


MODEL AV-2
$29.50
Shpg. Wt. 5 Lbs.

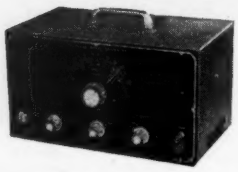
HEATH COMPANY A Subsidiary of Daystrom, Inc **BENTON HARBOR 15, MICH.**

MODEL HD-1
HARMONIC DISTORTION METER KIT

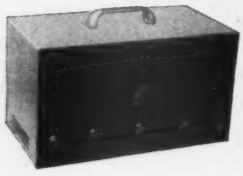
MODEL CR-1
CRYSTAL RECEIVER KIT



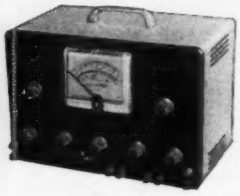
MODEL AG-9
AUDIO GENERATOR KIT



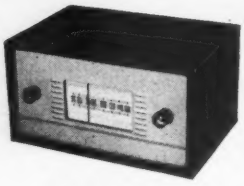
MODEL AG-8
AUDIO GENERATOR KIT



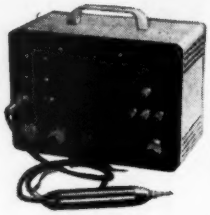
MODEL AO-1
AUDIO OSCILLATOR KIT



MODEL AA-1
AUDIO ANALYZER KIT



MODEL BR-2
BROADCAST BAND RECEIVER KIT



MODEL T-3
SIGNAL TRACER KIT

Heathkit HARMONIC DISTORTION METER KIT

Designed for use with low distortion audio generator, (such as the Model AG-9). Measures harmonic distortion of audio amplifiers under a variety of conditions. Reads distortion on meter as percentage of input signal. Operates between 20 and 20,000 cps. High impedance VTVM built in for initial reference settings and final distortion readings. VTVM ranges are 0-1, 3, 10, and 30 volts full scale. 1% precision resistors employed. Distortion scales are 0-1, 3, 10, 30, and 100% full scale.

MODEL HD-1
$49.50*
Shpg. Wt. 13 Lbs.

Heathkit CRYSTAL RECEIVER KIT

This crystal radio covers standard broadcast band (540 to 1600 kc). Employs two high-Q tank circuits. A sealed germanium diode is used for detection—no critical "cat's whisker" adjustment. Kit includes pair of high impedance headsets, and is easy to build, even for a beginner. Requires no external power.

MODEL CR-1
$7.95*
Shpg. Wt. 3 Lbs.

Heathkit AUDIO GENERATOR KIT

Low distortion audio generator (less than .1%). Ideal for use with Model HD-1, or in other applications requiring low signal distortion. Frequency accuracy within ±5%. Features step-type tuning from 10 cps to 100 kc, with three rotary switches that provide two significant figures and a multiplier. Output monitored on large 4½" meter. Meter calibrated for output voltage or db. Output ranges are 0-.003, .01, .03, .1, .3, 1, 3, and 10 volts.

MODEL AG-9
$34.50*
Shpg. Wt. 8 Lbs.

Heathkit AUDIO GENERATOR KIT

This generator covers from 20 cps to 1 mc in 5 ranges. Output constant within ±1 db from 20 cps to 400 kc, and down only 3 db at 600 kc. Produces good sine wave with distortion percentage below .4% from 100 cps through the audio range. Provides 10 volts output under no load conditions. Has continuously variable and step-type attenuator with settings of 1 millivolt, 100 millivolts, 1 volt, and 10 volts. Cathode follower output.

MODEL AG-8
$29.50*
Shpg. Wt. 11 Lbs.

Heathkit AUDIO OSCILLATOR KIT

(Sine Wave—Square Wave)

Produces sine wave or square wave signals from 20 to 20,000 cps in 3 ranges. Designed for use in service shop, or home workshop. Employs thermistor for output regulation. Features high level output, low distortion, and low impedance output. Produces sine waves for audio testing, or will produce good clean square waves with a rise time of only 2 microseconds. Very simple to build from complete instructions supplied.

MODEL AO-1
$24.50*
Shpg. Wt. 10 Lbs.

Heathkit AUDIO ANALYZER KIT

Combines AC VTVM, audio wattmeter, and intermodulation distortion analyzer in one instrument. Includes built-in high and low frequency oscillators for IM tests. VTVM ranges are .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 volts rms. Wattmeter ranges are .15 mw, 1.5 mw, 15 mw, 150 mw, 1.5 w, 15 w, and 150 w. IM scales are 1%, 3%, 10%, 30%, and 100%. Provides internal loads of 4, 8, 16, or 600 ohms. An extremely valuable instrument for the audio engineer, or for the serious audiophile.

MODEL AA-1
$59.50*
Shpg. Wt. 13 Lbs.

Heathkit BROADCAST BAND RECEIVER KIT

Build your own radio with confidence, even if you are a beginner. Features transformer power supply, miniature tubes, built-in antenna, 5½" PM speaker, and planetary tuning from 550 kc to 1600 kc. Complete step-by-step instructions supplied.

Cabinet, as shown, available separately.

MODEL BR-2
$17.50*
(less cabinet)
Shpg. Wt. 10 Lbs.

Heathkit VISUAL-AURAL SIGNAL TRACER KIT

Features a high-gain RF input channel for signal tracing and troubleshooting from the receiver antenna input clear through all RF and IF stages. Separate low-gain channel for audio circuit exploration. Built-in loudspeaker provides audio response, while electron beam "eye" tube gives visual indication. Ideal for signal tracing in AM, FM, and TV receivers. Built-in wattmeter and noise locating circuit.

MODEL T-3
$23.50*
Shpg. Wt. 9 Lbs.

HEATH COMPANY A Subsidiary of Daystrom, Inc. **BENTON HARBOR 15, MICH.**

Heathkit DX-100
PHONE & CW TRANSMITTER KIT

This transmitter is rapidly becoming the accepted standard in its price class. 100 watts RF output—built-in power supplies—built-in VFO and modulator—bandswitching on 160, 80, 40, 20, 15, 11, and 10 meters—phone or CW operation. 100 watts output on phone, and 120 watts on CW. TVI suppressed—pi network output coupling—extensive shielding—matches 50 to 600 ohms—high quality components. Uses 1625 tubes in push-pull to modulate 6146 tubes in parallel. Schematic and specifications available on request.

MODEL DX-100
$189.50
Shpg. Wt. 107 Lbs.

Heathkit DX-35
PHONE & CW TRANSMITTER KIT

This exciting new kit features bandswitching phone and CW operation on 80, 40, 20, 15, 11, and 10 meters. Plate power input to 65 watts on CW, with controlled-carrier modulation peaks to 50 watts on phone. Features built-in modulator, power supplies, pi network output circuit. Panel meter reads grid or plate current for 6146 final. Schematic and specifications on request.

MODEL DX-35
$56.95
Shpg. Wt. 24 Lbs.

Heathkit CW AMATEUR TRANSMITTER KIT

Outstanding dollar-per-watt value! 30-35 watts plate power input, bandswitching for 80, 40, 20, 15, 11, and 10 meters. Crystal or external VFO excitation. 52 ohm ouput—key click filter—copper-plated chassis—pre-wound coils. Uses 6AG7 ocsillator, 6L6 final.

MODEL AT-1
$29.50
Shpg. Wt. 15 Lbs.

Heathkit VFO KIT

Go VFO for added convenience and flexibility. Covers 160-80-40-20-15-11 and 10 meters. Three basic oscillator frequencies provide better than 10 volt average RF output. Plug for crystal socket of transmitter. VR tube for stability. Requires only 250 VDC at 20 ma, and 6.3 VAC at 0.45 A.

MODEL VF-1
$19.50
Shpg. Wt. 7 Lbs.

Heathkit ANTENNA COUPLER KIT

Matches between transmitter and a long-wire, end-fed antenna. Incorporates an L-type filter to attenuate signals above 36 mc and reduce TVI. 52-ohm coaxial input. Tapped inductor and variable capacitor. Neon RF indicator—simple to build. Handles up to 75 watts, 10 through 80 meters. Use with AT-1 or DX-35.

MODEL AC-1
$14.50
Shpg. Wt. 4 Lbs.

Heathkit "Q" MULTIPLIER KIT

Tunes any signal within IF of receiver, with effective Q of approximately 4,000. Sharp "peak" or "null" surpasses crystal filter in operation. Use with 450-460 kc IF. Will not function with AC-DC receivers. Requires 6.3 VAC at 300 ma, and 150-250 VDC at 2 ma. Cable and plugs supplied.

MODEL QF-1
$9.95
Shpg. Wt. 3 Lbs.

Heathkit COMMUNICATIONS TYPE ALL BAND RECEIVER KIT

Unusual sensitivity and selectivity for price. Covers 550 kc to 30 mc in 4 bands. AC power supply—electrical bandspread—antenna trimmer—separate RF and AF gain controls—noise limiter—headphone jacks—AGC—BFO. Cabinet available separately as shown. Part 91-15A, shipping weight 5 lbs. $4.50.

MODEL AR-3
$27.95
(Less Cabinet)
Shpg. Wt. 12 Lbs.

Heathkit GRID DIP METER KIT

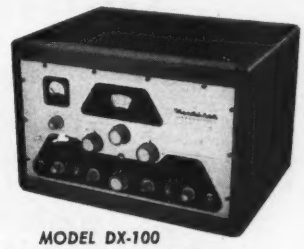
Use for determining unknown frequency, for checking resonance of tuned circuits, or for adjusting wave traps. Equally valuable in ham shack, service shop, or laboratory. Features 500 ua. meter with sensitivity control. Covers 2 mc to 250 mc with five coils, supplied with kit. Coils pre-wound, dial scale pre-calibrated.

MODEL GD-1B
$19.50
Shpg. Wt. 4 Lbs.

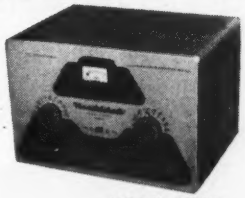
Heathkit
ANTENNA IMPEDANCE METER KIT

Use this instrument, with a source of RF signal, to determine antenna impedance, line impedance, and to solve impedance matching problems with fixed or mobile antennas or transmission lines. Also, will double as a field strength indicator, or phone monitor. Uses 100 ua. meter. Covers 0 to 600 ohms.

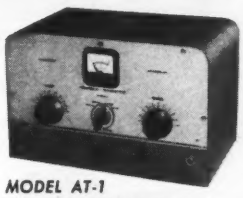
MODEL AM-1
$14.50 Shpg. Wt. 2 Lbs.



MODEL DX-100
PHONE & CW TRANSMITTER KIT



MODEL DX-35
PHONE & CW TRANSMITTER KIT

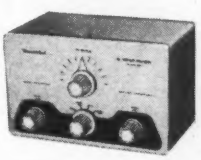


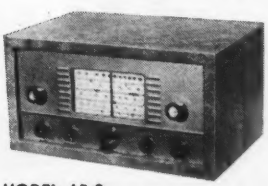
MODEL AT-1
CW AMATEUR TRANSMITTER KIT

MODEL VF-1
VFO KIT

MODEL AC-1
ANTENNA
COUPLER KIT

MODEL QF-1
"Q" MULTIPLIER
KIT





MODEL AR-3
ALL BAND RECEIVER KIT

HEATH COMPANY A Subsidiary of Daystrom, Inc. **BENTON HARBOR 15, MICH.**

MODEL W-5M

Heathkit ADVANCE-DESIGN HIGH FIDELITY AMPLIFIER KIT

This 25 watt amplifier incorporates the "extra" features required for really outstanding performance, and yet is priced within the range of the average audiophile. Employs KT66 output tubes in push-pull, and features the famous Peerless output transformer. Response is within ±1 db from 5 cps to 160 kc at 1 watt. Harmonic distortion only 1% at 25 watts, 20 to 20,000 cps. IM distortion only 1% at 20 watts. Output impedance is 4, 8, or 16 ohms. Hum and noise are 99 db below rated output. Features "tweeter saver," and unique balancing circuit. Handles power peaks up to 42 watts.

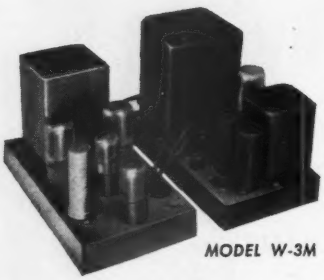
KIT COMBINATIONS:

Express only
$59.75
Shpg. Wt. 31 Lbs.

W-5M Amplifier Kit: Consists of main amplifier and power supply, all on one chassis. Complete with all necessary parts, tubes, and comprehensive manual.

W-5 Combination Amplifier Kit: Consists of W-5M Amplifier Kit listed above *plus* Heathkit Model WA-P2 Preamplifier Kit. Complete with all necessary parts, tubes, and construction manuals.

Express only—Shipping weight 38 lbs.....$79.50



MODEL W-3M

Heathkit DUAL-CHASSIS HIGH FIDELITY AMPLIFIER KIT

The Model W-3M features the famous Acrosound TO-300 "ultra linear" output transformer. It uses 5881 tubes and has a frequency response within ±1 db from 6 cps to 150 kc at 1 watt. Harmonic distortion only 1% at 21 watts. IM distortion at 20 watts only 1.3% at 60 and 3,000 cps. Power output is 20 watts. Output impedance is 4, 8, or 16 ohms. Hum and noise is 88 db below 20 watts. A very popular high fidelity unit. Main amplifier and power supply on separate chassis.

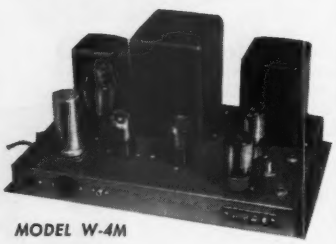
Express only
$49.75
Shpg. Wt. 29 Lbs.

KIT COMBINATIONS:

W-3M: Consists of main amplifier and power supply for separate chassis construction. Includes all tubes and components necessary for assembly.

W-3: Consists of W-3M Kit listed above *plus* Heathkit Model WA-P2 Preamplifier described on opposite page.

Express only—Shipping weight 37 lbs.....$69.50



MODEL W-4M

Heathkit SINGLE-CHASSIS HIGH FIDELITY AMPLIFIER KIT

Model W-4A is the original low-priced Williamson Amplifier Kit. A Chicago output transformer and 5881 output tubes are featured. Frequency response is ±1 db from 10 cps to 100 kc at 1 watt. Harmonic distortion only 1.5% at 20 watts. IM distortion only 2.7%. 20 watts output at 4, 8, or 16 ohms. Hum and noise 95 db below 20 watts. A tried and proven unit featuring a "polished" circuit that may be depended on for reliable high fidelity performance.

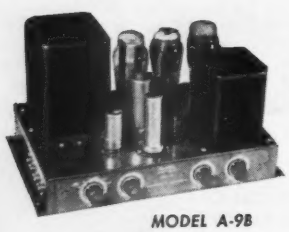
Express only
$39.75
Shpg. Wt. 28 Lbs.

KIT COMBINATIONS:

W-4AM: Consists of main amplifier and power supply for single chassis construction. Includes all tubes and components necessary for assembly.

W-4A: Consists of W-4AM Kit listed above *plus* Heathkit Model WA-P2 Preamplifier described on opposite page.

Express only—Shipping weight 35 lbs.....$59.50

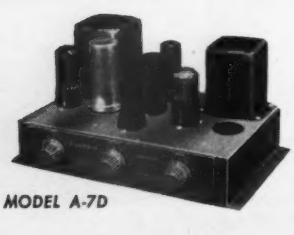


MODEL A-9B

Heathkit 20-WATT HIGH FIDELITY AMPLIFIER KIT

This amplifier can provide you with high fidelity at a surprisingly low price. Preamplifier built into same chassis as main amplifier. Four switch selected, compensated inputs are available, as are bass and treble tone controls, providing necessary flexibility for home or public address installations at a minimum investment. Features full 20-watt output using push-pull 6L6 tubes. Employs miniature tube types in preamp for low hum and noise. Frequency response is ±1 db from 20 to 20,000 cps. Harmonic distortion only 1% at full output. Shop and compare —a real "best buy" for you.

MODEL A-9B
$35.50
Shpg. Wt. 23 Lbs.



MODEL A-7D

Heathkit 7-WATT AMPLIFIER KIT

The 7-watt output of this amazing little amplifier is more than adequate for normal home installations. Using a tapped-screen output transformer of new design, its frequency response is ±1½ db from 20 to 20,000 cps. It provides good sensitivity, with surprisingly low distortion. Transformer tapped at 4, 8, and 16 ohms. Push-pull output. Separate bass and treble tone controls are provided.

MODEL A-7D
$16.95
Shpg. Wt. 10 Lbs.

MODEL A-7E: Same as Model A-7D, but with stage of preamplification. Extra gain for low level cartridges. RIAA compensation.

Shipping weight 10 lbs.....$18.50

SPECIAL NOTE: Don't overlook the possibilities of a hi-fi system consisting of the FM-3, the Model A-7E, and the Model SS-1 Speaker System. For only $82.95, you can have high fidelity in your home.

HEATH COMPANY A Subsidiary of Daystrom, Inc. **BENTON HARBOR 15, MICH.**

HEATHKIT®

Heathkit HIGH FIDELITY PREAMPLIFIER KIT

MODEL WA-P2

$19.75 (with cabinet)

Shpg. Wt. 7 Lbs.

Designed specifically for use with Heathkit main amplifiers. Features five separate switch-selected input channels, each with its own input level control. Four-position turnover and roll-off controls for record equalization. Separate bass and treble tone controls. Special hum control to insure minimum hum level. Will do justice to finest program sources. Beautiful satin-gold finish.

Heathkit AM TUNER KIT

MODEL BC-1

$24.50 (with cabinet)

Shpg. Wt. 8 Lbs.

Designed for use with high fidelity systems. Low distortion voltage-doubler detector. Covers 550 to 1600 kc. 20 kc IF bandwidth. Audio response ±1 db from 20 cps to 2 kc. 6 db signal-to-noise ratio at 2.5 microvolts. RF and IF coils pre-aligned. Power supply built-in. Efficient, modern circuit. Matches WA-P2 and FM-3 in color and style.

Heathkit HIGH FIDELITY FM TUNER KIT

MODEL FM-3

$24.50 (with cabinet)

Shpg. Wt. 7 Lbs.

This FM tuner offers sensitivity, selectivity, and stability, not expected at this price level. Efficient 7-tube circuit is entirely new, and incorporates AGC, cascode front end, temperature compensated oscillator, built-in power supply, and other outstanding design features. Only minimum adjustments required after assembly with pre-aligned IF and ratio transformers. Sensitivity is better than 10 microvolts for 20 db of quieting. Covers 88 to 108 mc.

Heathkit ELECTRONIC CROSS-OVER KIT

MODEL XO-1

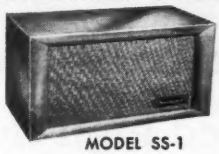
$18.95 *Shpg. Wt. 6 Lbs.*

The XO-1 separates high and low frequencies at selectable crossover points, to feed two separate power amplifiers, one for high frequencies and one for low frequencies. Speakers are then connected to the amplifiers directly, without the usual LC crossover. Separate level controls provided for both outputs. The XO-1 consumes no audio power. Crossover frequencies are 100, 200, 400, 700, 1200, 2000, and 3500 cps. Attenuation is 12 db per octave.

HIGH FIDELITY SPEAKER SYSTEM

The Models SS-1 and SS-1B are matched so that when the smaller unit is placed on top of the larger unit, the appearance of a single piece of furniture is achieved. They form an integrated 4-speaker system.

Heathkit HIGH FIDELITY SS-1 SPEAKER SYSTEM KIT



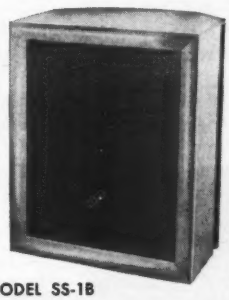
MODEL SS-1

$39.95 *Shpg. Wt. 30 Lbs.*

This speaker system employs two Jensen speakers to cover the frequency range from 50 to 12,000 cps. Response is within ±5 db through this range. Built-in crossover functions at 1600 cps. System rated at 25 watts, with nominal impedance of 16 ohms. Enclosure is a ducted-port bass reflex type. The attractive "picture frame" molding blends with any decorating scheme. You merely assemble the cabinet, wire the speakers and crossover network, and treat the furniture-grade plywood in the finish of your choice.

Heathkit HIGH FIDELITY SS-1B SPEAKER SYSTEM KIT

This Range Extending Speaker System employs a 15" woofer and a super tweeter to cover the frequencies between 35 and 600 cps, and between 4000 and 16,000 cps. When used with the Model SS-1, it extends the frequency range at both ends of the spectrum for a total coverage of ±5 db from 35 to 16,000 cps. Provides unbelievably rich sound over the audio range.



MODEL SS-1B

$99.95 *Shpg. Wt. 80 Lbs.*

Exposed panels are furniture grade plywood, suitable for light or dark finish of your choice. All parts are pre-cut and ready for assembly. The kit includes necessary crossover circuits and balance control. Crossover frequencies are 600, 1600, and 4,000. Power rating is 35 watts for speech and music. Nominal impedance is 16 ohms.

The SS-1B, alone, measures 29" high by 23" wide by 17½" deep.

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QUANTITY	ITEM	MODEL NO.	PRICE

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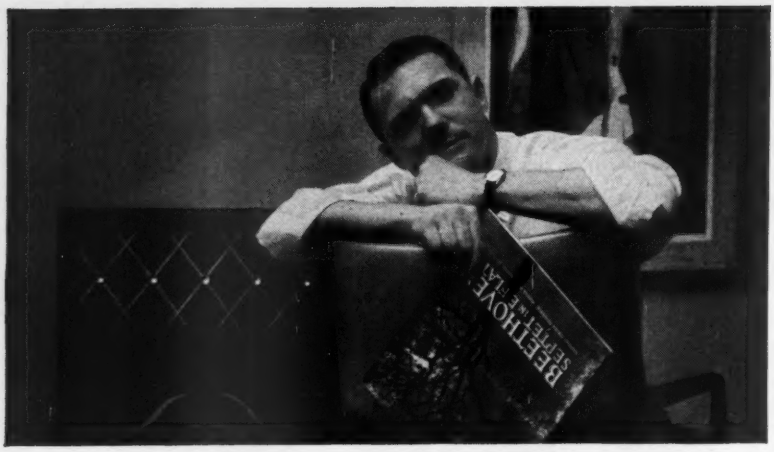

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Crystal Marker for TV Alignment

By **GUY DEXTER**

Add this simple circuit to your TV sweep generator for marking the 4.5 mc. sound channel point.

SELF-EXCITED oscillators are not accurate enough for marking the 4.5 mc. sound channel point in visual TV alignment. Crystal-type marker oscillators are used for this purpose.

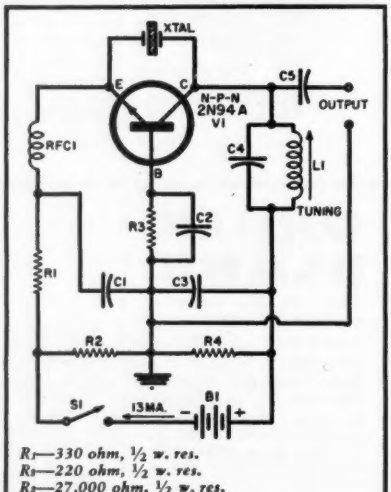
A number of earlier-model TV sweep generators still in use have no provision for crystal marker operation. A small external crystal oscillator would be desirable but usually is not built by the technician because of size and power requirements.

A transistorized crystal oscillator is an excellent alternative since it is small, requires little d.c. power, and has none of the complications introduced by power-line operation.

Fig. 1 is the circuit of a 4.5 mc. crystal oscillator employing a Sylvania 2N94A r.f. transistor. This is an "n-p-n" type. The circuit is resonated by means of a slug-tuned inductor, L_1. Peak deflection of an a.c. v.t.v.m. connected temporarily to the output terminals of the oscillator and set to its 10-volt range will indicate resonance. The resonant voltage is approximately 5 volts r.m.s.

The total current drain of 13 milliamperes can be supplied by five series-connected penlite cells, six mercury cells (8.07 volts), or a small, flat 7½ volt battery like the Burgess 5540. —30—

Fig. 1. Schematic of the crystal marker.



R_1—330 ohm, ½ w. res.
R_2—220 ohm, ½ w. res.
R_3—27,000 ohm, ½ w. res.
R_4—820 ohm, ½ w. res.
C_1, C_3, C_5—.01 μfd. mica capacitor
C_4—150 μμfd. silver mica capacitor
C_2—10 μμfd. mica capacitor
L_1—9-16 μhy., slug-tuned inductor (Miller #4506)
RFC_1—1½ mhy. r.f. choke (Miller #4532)
S_1—S.p.s.t. switch
B_1—7½ volt battery
Xtal.—4.5 mc. crystal
V_1—2N94A transistor (Sylvania)

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With DIAGRAM for Easy Conversion to CITIZENS' BAND!

Makes wonderful mobile rig for 420-500 Mc. Easy to convert for phone or CW 2-way communication. CONVERSION DIAGRAM INCLUDED. This swell rig originally cost over $1000—yours for practically a song! You get it all, in original factory carton, BRAND NEW, complete with 17 tubes, less power supply. **Conversion Instructions Included.** Shpg. wt. 25 lbs. **$29.50**

PE-101C DYNAMOTOR for BC-645, has 12-24V input (easy to convert for 6V Battery operation) ..... only **$7.95**
UHF ANTENNA ASSEMBLY, for BC-645 .... **$2.45**
Complete set of 10 Plugs for BC-645 ..... **$5.50**
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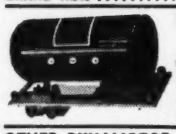
Model	Description	Excellent Used	BRAND NEW
HS-23	High Impedance	$2.25	$4.35
HS-33	Low Impedance	1.99	4.65
HS-30	Low Imp. (featherwt.) .	1.49	2.25
H-16/U	High Imp. (2 units) ...	2.75	7.95
CD-307A	Cords, with PL55 plug and JK26 Jack		.99

HI-FI DYNAMIC HEADSET with Cushions
Freq. Range: 40-14000 CPS. No Distortion. **BRAND NEW** **$5.95**



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Excellent Used **$8.98**

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DM-28	28V	224V .07A	$1.95	$4.95
DM-32A	28V 1.1A	250V .05A	2.95	5.95
DM-33A	28V 5A	575V .16A	1.95	3.95
	28V 7A	540V .25A	1.95	3.95
DM-34D	12V 2A	220V .080A	4.25	5.50
DM-37	25.5V 9.2A	625V .225A	5.95	8.95
DM-40	14V 3.4A	172V .138A	1.75	3.45
DM-53A	28V 1.4A	220V .080A	3.95	5.95
DM-64A	12V 5.1A	275V .150A	.....	7.95
PE-73C	28V 20A	1000V .350A	8.50	11.50
PE-86	28V 1.25A	250V .050A	2.95	5.24
PE-103	6V	500V .160A		
	12V	500V .160A	19.50	34.50
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INPUT: 28 V. D.C. @ 19 A.
OUTPUT: 1000 V. D.C. @ .350 A.
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T-24	Carbon Mike	....	3.95
TS-9	Handset	....	4.95

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Tapes for above available.

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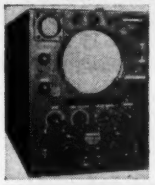

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200-500 Kc, 1500-12500 Kc using plugin units. 100 watts. Voice & CW.
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RADIO SET SCR-AR-283. Consists of: RECEIVER, 201 to 398 Kc and 2500 to 7850 Kc. TRANSMITTER, 2500 to 7700 Kc. for unmodulated, tone-modulated, or voice. Here's what you get, at this fantastically low price: Receiver complete with 6 tubes; transmitter complete with 4 tubes, Dynamotor for 24 V DC operation, 5 coil sets, 2 control boxes, antenna switching relay, operating manual. ALL BRAND NEW—and All Yours, for only.... **$15.95**

TS-161APN TEST SET

Very Special at this low price. **BRAND NEW.** Complete with all cables **$12.95**

Type 2J1F1 SELSYNS

Operates from 57½ volts, 400 cycles. New tested. Conversion diagram for 110 volts AC included. **BRAND NEW,** each **$2.95**
CAPS FOR ABOVE **50c**

TYPE APN/1 ALTIMETER

Complete with all tubes. Limited quantity at this special low price! **$8.95**

NAVY RECEIVER TYPE ARB

Four Band. 105 to 9050 kc. Low Freq., Ship, Broadcast—40 to 80 meters. Includes tubes and dynamotor, for 24 volt operation. Easily converted for 110 V., 12 V, or 6 V. Schematic included. Excellent Condition. Overall: 8¼" x 7¼" x 15¾". Wt. 30 lbs.
COMPLETE WITH ALL TUBES, Special **$21.50**

EE-8 FIELD PHONES

Talk as far as 17 miles! Dependable 2-way communication at low cost! Ideal for home, farm, field. Up to six phones can be used on one line. Each phone complete with ringer. Originally cost govt. $65.00 each. Excellent condition,
OUR PRICE, EACH **$16.66**

2-VOLT BATTERY "PACKAGE"!

1—2V. 20 Amp. Hr. Willard Storage Battery $2.45
1—2V. 7 prong Synchronous Plug-in Vibrator ... 1.49
1—Quart Bottle Electrolyte (for 2 cells) 1.45
ALL BRAND NEW! Combination Price... **$4.99**

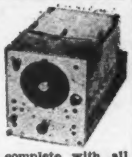
Willard 6-Volt Midget Storage Battery
3 Amp. Hour. **BRAND NEW.** 3⅝" x 1-13/16" x 2⅝". Uses Standard Electrolyte ..... Only **$2.22**

WRITE FOR FREE CATALOG!

Please include 25% Deposit with order—Balance C.O.D. MINIMUM ORDER $3.00. All Shipments F.O.B. Our Warehouse N.Y.C.

G & G Radio Supply Co.
Dept. N-7
51 Vesey St., New York 7, N. Y., CO 7-4605

BC-946B BROADCAST RECEIVER



520 to 1500 Kc. 6 tubes: 3—12SK7, 12SR7, 12A6, 12K8. For dynamotor operation. Easily converted to 110 or 32 Volt. 2—IF stages, 3-gang tuning cond. BRAND NEW, sealed carton, with tubes, manual, less dynamotor. **$19.95**

BC-457 TRANSMITTER—4-5.3 Mc, complete with all tubes and crystal. BRAND NEW **$8.95**
BC-458 TRANSMITTER—5.3 to 7 Mc. Complete with all tubes and crystal. BRAND NEW **$7.95**
BC-459 TRANSMITTER—7-9.1 Mc, complete with all tubes and crystal. BRAND NEW **$11.95**

SCR-274 COMMAND EQUIPMENT

ALL COMPLETE WITH TUBES

Type	Description	Used	Excellent Used	Brand NEW
BC-453	Receiver 190-550 Kc..	$9.95	$11.95	$14.95
BC-454	Receiver 3-6 Mc.....	7.19	8.29	11.95
BC-455	Receiver 6-9 Mc.....	5.25	7.95	9.95
BC-456	Modulator	2.24	2.75	4.24
BC-450	3-Receiver Control Box	...	1.49	1.95
BC-451	Transmitter Control Box	...	1.25	1.49
BC-696	Xmtr 3-4 Mc (like new)	...	7.95	10.95

110 VOLT AC POWER SUPPLY KIT FOR ALL 274-N RECEIVERS

Can be assembled quickly and easily. Plugs into the rear of any model 274-N receiver and delivers 24 volts as well as "B" voltage. No wiring changes needed. Complete kit of parts with metal case, instructions **$7.95**

SPLINED TUNING KNOB for 274-N RECEIVERS. Fits BC-453, BC-454 and others. Only **49c**

ARC-5/R-28 RECEIVER

2 Meter superhet, 100 to 156 Mc in 4 xtal channels. Louvred alum, cabinet 7⅝ x 4⅛ x 14". Complete with 10 tubes and 4 xtals.
Excel. Cond. **$14.95**

ARC-5/T-23 TRANSMITTER

Companion for above, incl. 2-832A, 2-1625 tubes and 4 xtals **$14.95**
Less Tubes **$6.95**

ARC-5 MARINE RECEIVER-TRANSMITTER
Navy Type Comm. Receiver 1.5 to 3 Mc BRAND NEW with 6 tubes **$16.95**
Navy Type Comm. Transmitter 2.1-3 Mc BRAND NEW with 4 tubes and Xtal **$12.45**

SCR-522 FINEST 2-METER RIG!

Terrific buy! VHF Transmitter-Receiver, complete with all components. 100-156 Mc. 4 channels. Xtal-controlled. Amplitude modulated voice. They're going fast! Excellent condition.
SCR-522 Transmitter-Receiver, complete with all 18 tubes. COMBINATION ..... Special **$33.33**
Receiver Only, with all tubes **$19.50**
Transmitter Only, with all tubes **$32.25**

LORAN APN-4 FINE QUALITY NAVIGATIONAL EQUIPMENT

Determine exact geographic position of your boat or plane! Complete, BRAND NEW installation consists of: ID-6B/APN-4 Indicator; R-9B/APN-4 Receiver; PE-206 Inverter; Set of Plugs; Visor for Indicator; Operation manual; Brand New, Export packed. **COMPLETE** **$129.50**

R65/APN-9 LORAN Receiver-Indicator, complete with tubes and operating manual, BRAND NEW, export packed **$295.00**

SPECIAL APN-9A LORAN Receiver Indicator, less tubes, NEW (demilitarized) **$29.50**

BC1206-C BEACON RECEIVER

195 to 420 Kc. made by Setchel-Carlson. Works on 24-28 volts DC. 135 Kc. IF. Complete with 5 tubes. Size 4" x 4" x 6". Wt. 4 lbs. BRAND NEW.. **$8.88**
Brand New, less tubes.. **$5.95**

BRAND NEW, less tubes **$5.95**
USED, with tubes **5.95**
USED, less tubes **2.95**

BC-221 FREQ. METER

Limited quantity, first come first served! Range 125 to 20,000 Kc with crystal check points in all ranges. Complete with tubes, crystal, calibration charts. Excellent condition. **$111.11**

BC-221 FREQ. METER CASE

Aluminum case for BC-221 or TS-164 Freq. Meters. With volt. reg. supply using VR105. 2 ballast tubes, relay, cable, etc. Inside front: 9¾ x 7½ x 7⅝". Inside rear: 2" deep. Shock-mounted.

BRAND NEW, (Add 50c for packing) **$3.99**

Original Crystal for BC-221 1000 Kc BRAND NEW **$8.45**
COMPLETE OPERATING MANUAL for BC-221 Freq. Meter **$1.95**

BC-442 ANTENNA RELAY UNIT

Wonderful Value! Consists of ¾ amp 2" RF Ammeter (antenna current indicator, 0-10 scale, Transmitter-Receiver Switching relay, in aluminum case with associated components. **BRAND NEW** **$2.24**

The New

GOODMANS

plus
YOUR LOUDSPEAKER

plus
A SIMPLE ENCLOSURE
only two-thirds the size required for a bass reflex

will give you
IMPROVED
SPEAKER SYSTEM
PERFORMANCE...
through 'Friction Loading'

- Extended bass response to 20 cycles
- Virtually no peaks above this frequency
- Effective air-loading to zero cycles — greatly reducing distortion due to excessive cone displacement

See your hi-fi dealer, or write for complete details to Dept. RG-5

ROCKBAR CORPORATION
650 Halstead Avenue, Mamaroneck, N. Y.

In Canada: A. C. Simmonds & Sons, Ltd., Toronto, Can.

New Hi-Fi-Audio Equipment

TAPE TIMING CHART

Reeves Soundcraft Corp., 10 East 52nd Street, New York 22, New York has added a timing chart to its line of audio accessories.

The need for a timing chart has become increasingly apparent because of the confusion that has developed through the introduction of long-play and extra-long-play recording tapes.

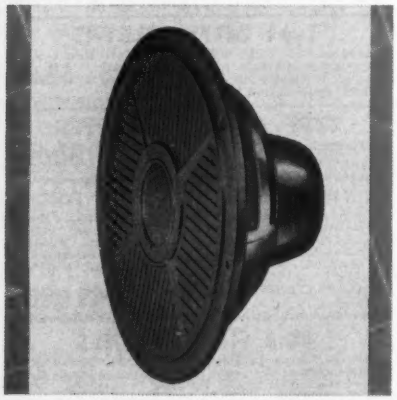
The chart enables the user to determine at a glance the time and length factors used in tape recording. Because the chart is semi-logarithmic, it is exceedingly accurate in determining the length and time factors for short commercial and spot announcements.

The company's dealers are handling this item which sells for $1.20.

G-E COAX SPEAKER

The *General Electric Company* is now marketing a 12-inch dual coaxial high-fidelity loudspeaker which has been designated as the "Golden Co-Ax" Model A1-401.

The speaker is rated at 25 watts and provides smooth response from 40 to 15,000 cps. The unit consists of a 12" woofer and a 2¾" tweeter with a built-in crossover network. The specially-designed slotted baffle plate serves as a baffle for the tweeter and a low-pass filter which reduces interference between the woofer and tweeter waves. The baffle plate is finished in gold so that the speaker can be front-mounted without covering.



A data sheet on the "Golden Co-Ax" is available from the company's audio department at Syracuse, New York or from the firm's sound distributors.

NEW SHURE ITEMS

Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Illinois has added two new items to its line of audio components.

The Model "535 Slendyne" microphone is of the dynamic type. It can be used in the hand, on a floor stand, on a desk stand, or hung around the neck on a lavalier cord and clip assembly. The mike also has an "on-off" switch adapter and a dual-impedance switch to provide a versatile, rugged unit.

The second item is a replacement cartridge kit, the RK56. The three cartridges in the kit provide dependable, quickly installed replacements for 217 cartridges of seven manufacturers. The kit includes a Model MC10, a Model W70, and a Model W72.

"ACOUSTIC GATE" MICROPHONE

Altec Lansing Corp., 9356 Santa Monica Boulevard, Beverly Hills, California is now marketing a new dynamic microphone for broadcast or p.a. use which incorporates the firm's unique "Acoustic Gate" principle.

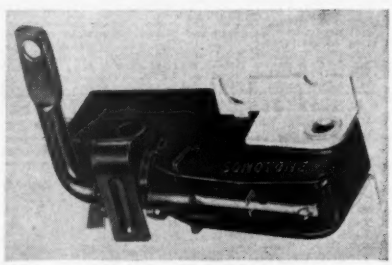
A peripheral sound entrance channel of 2 mil width, the "Acoustic Gate" provides an acoustical resistance loading, virtually independent of frequency to the front of the diaphragm, thereby eliminating high-frequency peaks and extending the smooth frequency response over an exceptionally wide range. This design also lessens the effects of wind, water, dirt, or weather and allows the microphone to be used under adverse conditions.

Write Dept. RV-6 of the company for full details and specifications.

CERAMIC CARTRIDGE LINE

Sonotone Corporation, Elmsford, New York is currently marketing a new line of ceramic phonograph cartridges which has been designated as the "3" series.

One of the units in the line is the "3T," a turnover type which plays records at all speeds. Diamond needles are recommended to insure the full benefits of the performance characteristics of the cartridge, although the unit is also available with sapphire needles if desired.



The color scheme is jet black and gold. Since this entire line is of the

ceramic type, equalizers and preamplifiers are not required.

"HI-FI TECHNIQUE"

M. A. Miller Manufacturing Co., 4th & Church Streets, Libertyville, Ill. has introduced a new product designed to clean records and keep them static free.

Tradenamed "Hi-Fi Technique," the product consists of a two-step operation involving the use of a special cellulose sponge and an anti-static lubricant. The lubricant is in spray form

and is applied in a fine mist over the record after the record has been washed with the special sponge.

The product is being marketed as a package with the aerosol can and sponge packed together in an polyethylene pouch.

Address requests for further information on this product to the sales manager of the company, Leroy W. Mintz.

PORTABLE DISC RECORDER

A new portable disc recorder and playback reproducer, known as the "Imperial," has been introduced by *Rek-O-Kut Company,* 38-01 Queens Blvd., Long Island City 1, New York.

This deluxe model features a newly-designed overhead cutting lathe with interchangeable leadscrews and with provision for making run-in and run-

off grooves. It is also calibrated for timing.

Another new feature of the "Imperial" is the new cutting head having a recording range from 50 to 10,000 cps. A tone arm for records up to 16" is included with a dual-sapphire *G-E* variable reluctance cartridge.

The amplifier serves for both re-

Having trouble with AGC or SWEEP systems?

"Servicing AGC Systems"
by
Henry A. Carter and Thomas A. Lesh

This practical book describes in detail the operation of the various types of Automatic Gain Control systems used in commercial TV receivers. Provides a clear explanation of AGC circuitry and describes the best servicing techniques to be applied toward finding and correcting AGC troubles. Symptoms of AGC troubles are shown in actual photographs as they show up on the picture tube. An invaluable book for TV Service Technicians. 132 pages; fully illustrated; 5½ x 8½". Order today; postpaid only..... **$1.75**

"Servicing TV Sweep Systems"
by
Jesse Dines

Describes the operation, circuit function and circuit variation of the different types of vertical and horizontal sweep systems common to most TV receivers. Describes best methods for analyzing circuits and for trouble-shooting the vertical and horizontal sweep systems; fully supported by helpful photographs, waveforms and service hints covering specific troubles. Also discusses construction of sweep transformers, coils and deflection yokes. 212 p., 5½ x 8½"; fully illustrated. Postpaid, only.... **$2.75**

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☐ **SERVICING AGC SYSTEMS..... $1.75**

☐ **Color TV Training Manual.** Prepares the Technician for Color TV service work. Covers principles of the Color TV system; Color receiver circuits; installation and servicing sets. Includes color blocks outlining the use of color test equipment. 260 pages; 8½ x 11"; 300 illustrations. **$6.95**

☐ **TV Test Instruments.** Revised and enlarged to include latest data on instruments used in Color TV servicing. Tells clearly how to operate each type of test instrument used in TV service work. 180 pages; 8½ x 11"; illustrated..... **$3.50**

☐ **Key Checkpoints in TV Receivers.** Prepared by the Howard W. Sams engineering staff. Provides many applications for general TV service work, including time-saving information on how to make quick tests at key points to determine where trouble lies, and how to check overall performance of the receiver after repair, to insure against callbacks. 182 pages; 5½ x 8½"; illustrated..... **$2.00**

☐ **Analyzing and Tracing TV Circuits.** Presents a new approach to TV servicing. 168 pages, 8½ x 11"..... **$3.00**

☐ **Photofact Television Course.** Gives a clear complete understanding of TV principles, operation, practice. Used by thousands of students. 208 pages, 8½ x 11"..... **$3.00**

☐ **Radio Receiver Servicing.** Covers the basic receiver types—gives time-saving hints for solving basic troubles, such as dead set, weak set, noisy set, etc. 192 pages; 5½ x 8½"..... **$2.50**

☐ **Technical Dictionary.** Over 4,000 definitions of radio, television, electronic, electrical and radar terms. Includes valuable charts, graphs, diagrams and symbols. Flexible binding for "on-the-job" use. 160 pages; 5½ x 8½"..... **$2.00**

☐ **SERVICING TV SWEEP SYSTEMS..... $2.75**

☐ **Tape Recorders—How They Work.** Explains recording theory, tape characteristics, motorboard mechanisms, drive motors, amplifiers, magnetic heads, volume indicators, equalization circuits—covers everything you want to know about recorders. 176 pages; 5½ x 8½". **$2.75**

☐ **The Recording and Reproduction of Sound.** Oliver Read's best-seller on audio and Hi-Fi. Covers theory of sound, basic recording methods, phono reproducers, amplifiers, speakers and enclosures, attenuators and mixers, tuners, home music and P.A. systems. 810 pages; 6 x 9"..... **$7.95**

☐ **Transistors—Their Application in Television-Radio-Electronics.** The first practical, complete book on transistors; explains circuitry, installation, testing techniques, theory and servicing. 100 pages; 5½ x 8½" illustrated..... **$1.50**

☐ **So You Want to Be a Ham.** Tells you what you need to know about getting your license and acquiring equipment. Covers such subjects as: Conquering the Code; Getting Your Ticket; Going on the Air; Electronics as a Career; etc. 196 pages; 5½ x 8½"; illustrated..... **$2.50**

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AMERICA'S GREATEST TUNER BUY!

The Sensational

Granco FM TUNER

Amazing Value... $34.95* in walnut

Compare its performance with high priced tuners

PROVIDES ENDLESS HOURS OF STATIC-FREE AND DRIFT-FREE FM LISTENING PLEASURE

The perfect addition to any HI-FI system, TV set, phonograph or tape recorder!

Model T-160

- **Frequency Range:** 88-108 Mc.
- **Selectivity:** 200 Kc at 3 db points.
- **Audio Frequency Response:** 20 cps to 20,000 cps.
- **Sensitivity:** 4 microvolts for 20 db quieting.
- **Coaxial Tuner:** Exclusive Granco feature assures drift-free reception.
- **Hum Level:** 70 db below 1 volt.
- **Maximum Audio Output:** 2 volts.
- **Antenna Input:** 300 ohms or built-in line cord antenna.
- **Overall Dimensions:** 7" w. x 5" h. x 4¾" d.

ASK YOUR DEALER FOR A DEMONSTRATION

See and hear Granco's FM and FM-AM table radios and high fidelity radio-phonograph combinations

*Price slightly higher in West and South

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GRANCO PRODUCTS, INC.

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World's only manufacturer specializing in FM

All Tubes Unconditionally Guaranteed For 1 Year

PRETESTED TUBES			INDIVIDUALLY BOXED		
0Z4	6AC7	6BK5	6SK7GT	12AL5	12SQ7
1B3GT	6AG5	6BK7	6SL7GT	12AT7	12SR7
1H5GT	6AG7	6BL7GT	6SN7GT	12AU6	19BG6G
1LC5	6AF4	6BQ6GT	6SQ7	12AU7	25BQ6GT
1LN5	6AK5	6BQ7	6SR7	12AV6	25L6GT
1N5GT	6AL5	6BY5G	6T8	12AV7	25W4GT
1Q5GT	6AQ5	6BZ7	6U8	12AX4GT	25Z5
1R5	6AS5	6C4	6V3	12AX7	25Z6GT
1S4	6AT6	6CB6	6V6GT	12BA6	35B5
1S5	6AU6	6CD6G	6W4GT	12BE6	35C5
1T4	6AU5GT	6F6	6W6GT	12AZ7	35L6GT
1T5GT	6AV5	6H6GT	6X4	12BH7	35W4
1U4	6AV6	6J5GT	6X5GT	12BY7	35Y4
1U5	6AX4GT	6J6	6Y6G	12SA7	35Z5GT
1X2	6AT6	6K6GT	7C5	12SG7	50A5
3Q4	6AH4GT	6L6	7C6	12SJ7GT	50B5
3S4	6BA6	6S4	7E7	12SK7	50C5
3V4	6BC5	6S8GT	7F7	12SL7GT	50L6GT
5U4G	6BE6	6SA7	7F8	12SN7GT	117Z3
5V4G	6BG6G	6SH7	7N7		
5Y3	6BJ6	6SJ7GT			
6AB4					

Now Get Up to $5 For Your Old TV Tube!

BIG TRADE-IN

upon the purchase of a **BRAND NEW DUMONT or RCA lic. PICTURE TUBE**

Ship dud prepaid . . . If you supply dud, deduct from the list prices as follows:

10"-14"—$2 | 15"—$2.50 | 16"-17"—$3.50 | 19"—$4 | 20"—$4.50 | 21"—$5

Prices indicated below are without trade-in.

10BP4	$10.95	15DP4	$16.95	16RP4	$17.00	19AP4	$23.00
12LP4	12.95	16DP4	18.50	17PB4	19.00	20CP4	24.00
12QP4	12.95	16GP4	18.95	17GP4	21.00	21ALP4A	24.00
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Picture Tubes Shipped F.O.B. Passaic, N. J.

Shipped Via Railway Express Dept. MR-7 PRescott 3-0330

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NEW QUICK 24 HOUR SERVICE AVAILABLE!

ANY ASSORTMENT RECEIVING **TUBES 41c** ea.

Quantity Buyers!

100 Tubes — $38.00

FREE POSTAGE on all prepaid Continental U. S. A. orders. 25c handling charge on all orders under $5.00. 25% Deposit on all C.O.D.'s. Subject to prior sale. Write for FREE TUBE LIST!

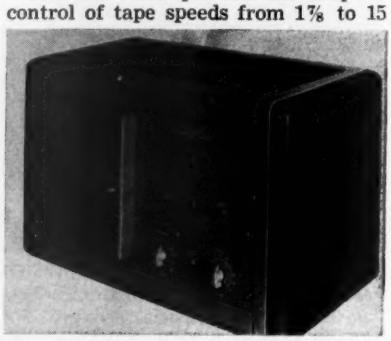
cording and playback and has high level and low level inputs for recording live, from tape, off-the-air, or from other record discs. A recording level meter is mounted on the control panel which also includes volume, level, and mixing controls.

Write Avery Yudin, sales manager of the company, for full details, prices, and specifications.

"MAGNELOOP"

Amplifier Corporation of America, 398 Broadway, New York 13, New York has developed and is now marketing an entirely new tape drive system for its continuous loop magnetic tape recorder.

The new unit permits the stepless control of tape speeds from 1⅞ to 15



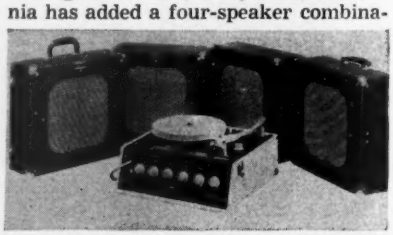
ips with a frequency response of 50 to 15,000 cps at the higher speed. Continuously variable automatic equalization and amplitude compensation are incorporated. Unusual recording and playback possibilities are created because speed control over an 8 to 1 ratio is now possible on a single unit.

Recorders, reproducers, or recorder-reproducers are available in single, dual, and triple channel models each incorporating a shock-mounted ruggedized low-noise-level preamp, a 100 kc. ultrasonic bias and erase oscillator, and an efficient d.c. motor.

Write the manufacturer for complete information on this new "Magneloop" series.

FOUR-SPEAKER P.A. SYSTEM

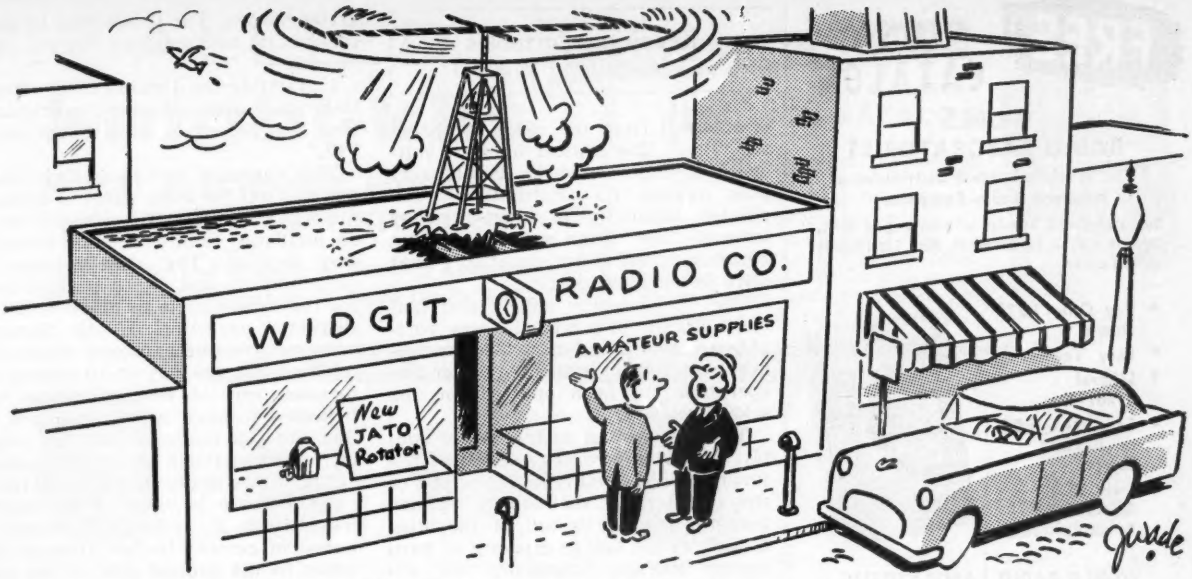
Newcomb Audio Products Co., 6824 Lexington Avenue, Hollywood, California has added a four-speaker combina-



tion transcription player-public address system to its line of portable equipment for use in large halls, gyms, and out of doors.

The TR-25AM-4 unit assembles into three portable carrying cases. Four 12-inch *Alnico* V PM speakers are capable of covering any room size with hi-fi sound from records or microphones. The new equipment has a 25-watt amplifier with frequency response

(*Continued on page* 113)



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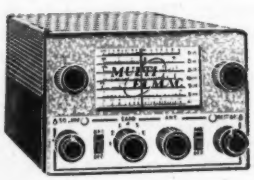
Brand new, government surplus. 12 VDC input. 440 VDC, 400 ma output. Can be filtered with 2 mfd paper condenser. Starting relay not included. Has snap-on mounting plate with Jones S-412-AB socket for input and output leads. Size 5¾Hx4½Dx9"W, and weighs 13½ lbs. Net.....$ 14.95

Don't get yourself in a whirl thinking about how you can pay for that new ham gear you have been dreaming about. Your used (factory-built) communications and test equipment, plus a Walter Ashe "Surprise" trade-in allowance, will go a long way toward making your dream come true. Here is how – just tell us what used equipment you have to trade and what new gear you want. Our liberal, money-saving "Surprise" trade-in allowance will more than please you. Get your trade-in deal working today. Wire, write, phone, or use the handy coupon.

MULTI-ELMAC TRANS-CITER MODEL AF-67. Net.....$ 177.00

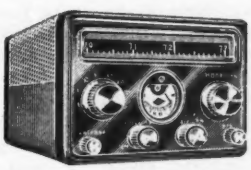
VIKING "PACEMAKER"

New transmitter for SSB, AM, and CW. Built-in VFO. Wired and tested. Net.....$ 495.00



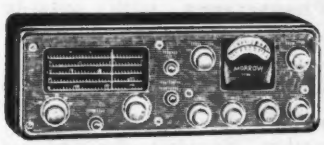
MULTI-ELMAC PMR-7 MOBILE RECEIVER. Less Power Supply. Net.....$ 159.00

PSR-612 POWER SUPPLY. 6-12 VDC. Net.....$ 34.00



GONSET G-66 RECEIVER. Less power supply and speaker. Net.....$ 169.50

Power Supply. 6-12VDC-115VAC. Built-in speaker. Net.....$ 39.95



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Repairing Portables

(*Continued from page* 51)

is obtained from the same source as the "B+." The critical filament voltage of the 1R5 converter has already been treated. Its contribution to oscillator instability is aggravated by lowered "B+" from an old selenium rectifier or old filter capacitors that have developed leakage.

The "B+" power supply and filament circuits of a typical 3-way portable are shown in Fig. 6. The changeover switch from battery to power line operation has been omitted for the sake of clarity.

The first test on such a power supply should be a voltage check at the junction of R_{14} and R_{15}—the output of the rectifier. If the voltage is low, then the rectifier is bad, or the filter capacitors are low in capacity or have excess leakage (assuming the absence of a shorted tube or component).

Rectifier SE_1 can be checked by shunting it with another test rectifier as indicated in Fig. 6. Observe proper polarity. The output voltage (junction R_{14}, R_{15}) will rise irrespective of whether the selenium in the circuit is good or bad. If the amount of rise is 5% or less (about 5 to 6 volts) then the rectifier is good. If the rise is more than this percentage, then the selenium is bad regardless of resistance checks on it. The bridging test is far more conclusive than testing the forward and the back resistance with an ohmmeter. Be sure to use a test rectifier with the same rating as the one in the set—do not use one appreciably different in rating or the test will not furnish the desired information.

If the rectifier is OK or has been replaced and the "B+" voltage is still low, try bridging the input filter capacitor (C_{23}, 40 μfd., in Fig. 6). In the absence of short circuits, this will bring the input voltage up to par. *Do not use a capacity appreciably greater than that of the unit being bridged.* The surge may blow the weakest tube in the filament string.

Failure of the filament filter capacitor C_{22} will permit audio current to travel to the 1st audio, i.f., and converter stages. The result may be motor-boating and assorted "burps" and squeals.

If shunting the filament filter capacitor (C_{22}) eliminates the symptom, then it is defective. This is test point "T3."

This capacitor can have high leakage and rob the other tubes of enough filament current so that trouble such as oscillator failure or 3V4 burnout may develop. The same is true of capacitors C_{20} and C_{21}. A positive test for this condition is to disconnect the suspected capacitor. If the filament voltage rises, the capacitor should be replaced. Do not rely on an ohmmeter measurement of leakage unless the indicated leakage is definitely out of line. Also, do not use a very low range of the ohmmeter in testing this circuit "cold," tubes can be blown easily here!

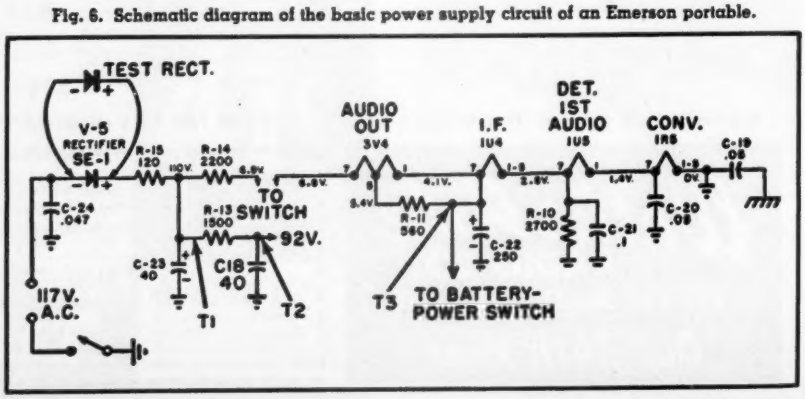
An increase in value of the shunting resistors R_{10} and R_{11} will permit an excess of current to flow through the tubes to the ground side of the filament string. Premature burnout may result. When checking with an ohmmeter, remove the tubes.

Opening of the second "B+" filter capacitor (C_{18}, 40 μfd.) may result in whistles and high-pitched squeals plus hum. There will also be a slight lowering of "B+" at both test points "T2" and "T1," since this capacitor helps C_{23} hold up the d.c. voltage at "T1," the rectifier output. Shunt with a test capacitor to check for low capacity. Disconnect the capacitor and observe the d.c. voltage as a test for excess leakage; the d.c. voltage will rise appreciably if C_{18} is defective.

Numerous modern portable radios employ a printed circuit for audio coupling—a "Couplate" or similar unit. With a defective component in such a circuit, it is advisable to replace the entire unit rather than endeavor to shunt the defective component with another or make a similar type repair. The danger is that the original part (capacitor, resistor, etc.) left in the "Couplate" may change its value or connect itself back into the circuit. The result may be instability in one form or another.

Take care in testing these "Couplates" since they may crack and the damage may be latent only to show up at some subsequent date. —30—

Fig. 6. Schematic diagram of the basic power supply circuit of an Emerson portable.



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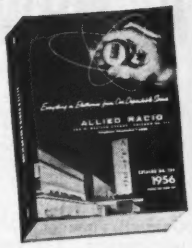

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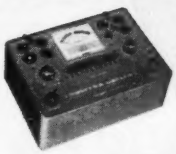

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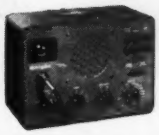

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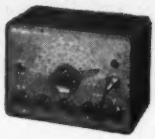

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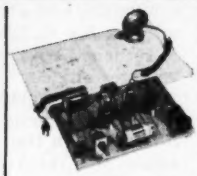

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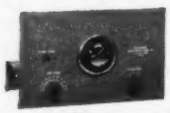

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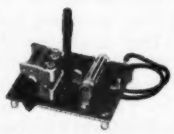

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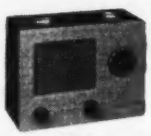

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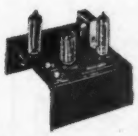

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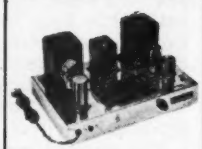

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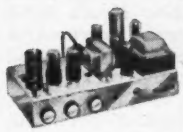

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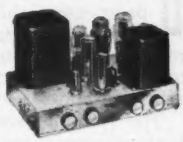

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A New Radiation Counter

Over-all view of the radiation counter. The coil cord on the probe prevents unnecessary tangling of leads.

Operational details on a recently introduced Geiger counter unit which provides "professional" results at moderate cost.

DESIGNED for the serious uranium prospector, the new *Heath* RC-1 radiation counter incorporates many of the features normally found only in the expensive, extremely sensitive units used by professionals.

The circuit employs a prewired, high-voltage supply with a four-tube amplifier and pulse shaper. A 4½ inch meter, calibrated in counts-per-minute, gives full-scale readings from 100 to 60,000 cpm. In addition, the meter is calibrated in milliroentgens per hour from .02 to 10 mr/hr. full scale.

A glance at the circuit diagram below will show that loudspeaker indication has been incorporated in addition to the meter. The circuit is excited by a transistor oscillator which provides a pleasant tone for monitoring. A panel control cuts out the loudspeaker circuit as desired.

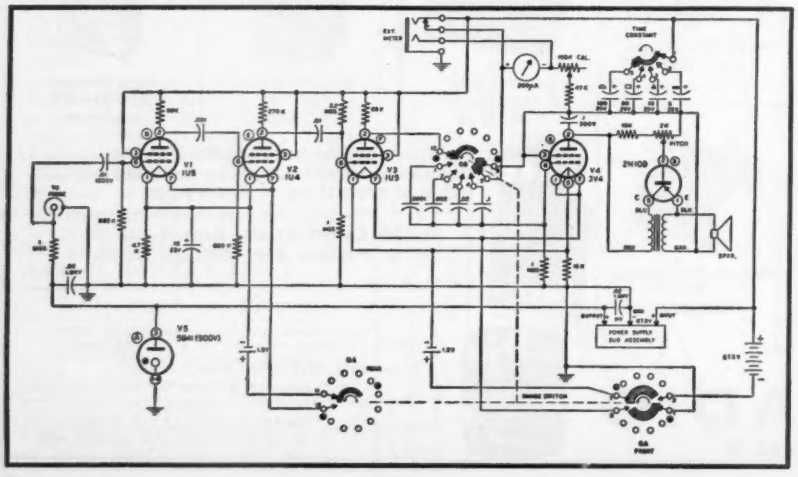
The counter incorporates four "cpm" ranges: 0-100, 600, 6000, and 60,000 and four milliroentgen ranges: 0-.02, .1, 1, and 10. The time constant of the circuit can be adjusted from .5 to 10 seconds in steps of .5, 1, 5, and 10 seconds.

The probe, which houses the 6306 bismuth counter tube, is of satin aluminum and chrome-plated steel. A coiled cord between the probe and the instrument helps to prevent tangling.

The unit is powered by one 67½ volt "B" battery and two 1½ volt "A" batteries. The "B" battery lasts approximately 200 hours in intermittent operation while the "A" batteries should last about 20 hours under the same operating conditions.

The entire instrument is housed in an aluminum cabinet which measures 9½" high, 6½" wide, and 5" deep. The complete unit weighs 6½ pounds. A top-mounted handle facilitates the transportation of the unit.

Complete schematic diagram of the Heath RC-1 radiation counter in kit form.



How The Counter Works

In the circuit of the RC-1, negative pulses generated in the probe are impressed across the input grid resistor through the .01 μfd. blocking capacitor (see diagram) and are amplified and inverted by V_1, appearing across the 68,000-ohm plate load resistor. V_2 further amplifies and re-inverts the signal pulses and injects them into the grid of V_3. The two stages of amplification are so designed to provide a sensitivity of approximately .1 volt and to limit at an input of .25 volt. This design insures a pulse of proper amplitude for triggering V_3 even though the input pulses may vary considerably in height.

V_3 and V_4 together comprise a monostable multivibrator. These two tubes have a common 15,000-ohm cathode resistor which serves as one leg of the coupling impedance necessary for oscillation and also as a source of cut off bias for V_4. The control grid of V_3 is returned to a positive point on the voltage divider connected between "B+" and ground, causing it to conduct. This conduction causes current flow through the common cathode resistor and the voltage drop across it is sufficient to cut V_4 off, since the grid of V_4 is returned to ground. This makes it possible to use a tube of comparatively large emission capabilities without increasing the "B" battery drain since V_4 doesn't draw current except during the short operating cycle following each input trigger.

The range switch connects various precision capacitors between the plate of V_3 and the grid of V_4 and, in conjunction with the common cathode resistor, provides the necessary cross coupling to enable multivibrator operation. The capacitors switched between the two tubes determine the period of time the multivibrator will remain in its unstable state. This, in turn, determines the average current flowing through the meter.

The aural monitoring circuit features a special 2000-ohm "pitch" control which enables the user to select the tone most pleasing to his ears. This is a front-panel control.

The RC-1 is being offered in kit form for $79.95 complete with probe, step-by-step assembly instructions, and details on how to use and troubleshoot the instrument. —30—

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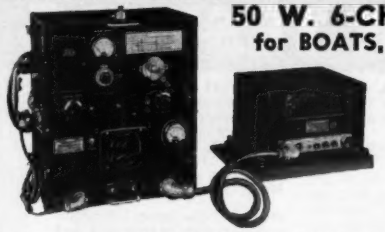

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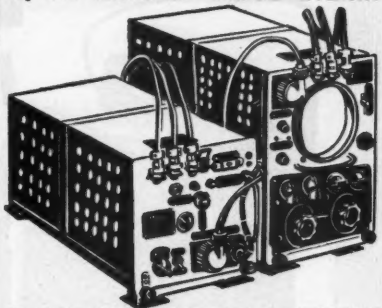

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This unit (BC-1100, part of RC-263) is exceptionally well-built and finely engineered with versatile features that make it a splendid transmitter for Ham or Commercial use. Frequency coverage is **1.5 to 10.0 mc; 4-channels** of either **crystal or VFO** control are provided, each channel covering the entire 1.5 to 10.0 mc range: **Power Output** is conservatively rated at 50 W. Phone and 75 W. CW, but actual output is 25% more; **Operation** is from any power source **100 to 260 V. AC 25 to 60 cycles; Automatic Dialing** controls power "on" or "off," channel selection, phone or cw, etc.; **REMOTE CONTROL** (RM-40) with Automatic Dial permits complete control of all aforementioned operations (transmitter can be in cellar, attic, garage, or any remote point up to 11 miles distance) over 2 pairs of wire, and includes a microphone amplifier and line level indicating meter. Transmitter circuit employs a 6L6 as crystal or VFO oscillator, a 6L6 as Buffer-Doubler, and 3 807 tubes in RF Power Stage; modulator section has a 6J5 speech amplifier stage and 4-6L6 tubes in power stage. Power Supply section uses a 5Z3 low-voltage rectifier, 2-RK60's as high-voltage rectifier. Remote Control uses a 6J5 speech amplifier and an 80 rectifier. Additional feature is Pi-Network in Antenna circuit to reduce harmonic radiation and interference.

PRICE, BC-1100 TRANSMITTER, NEW-UNUSED, With all tubes, Instruction Book, Microphone, export packed. Shpg. wt. total (cases) 600 lbs. **$239.50**

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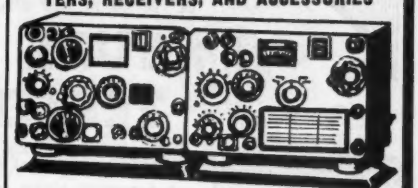

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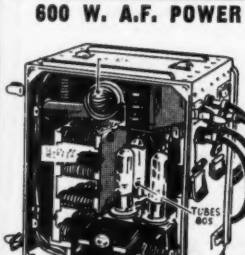
TCS-5(to 14) RECEIVER, complete with tubes and schematic diagram, as described above. Shpg. wt. 50 lbs. **EACH** **$69.95**

WRITE FOR PRICES ON OTHER TCS ACCESSORIES.

600 W. A.F. POWER AMPLIFIER



Designed by Bell Telephone Laboratories, ruggedly constructed 600 Watt Audio Power Amplifier. Ideal for use in airports, shipyards, or wherever high intensity sound may be required. Comprises push-pull audio power stage utilizing 4 —805 power triodes in push-pull parallel, with built-in motor blower for cooling. High voltage power supply uses selenium rectifiers, no tubes. Requires 40-60 watt per-amplifier to drive to full capacity. Input impedance 250/500 ohms, output impedance 19/6.5 ohms (to speakers). Operates from 115 to 230 Volts, 3 phase 50/60 cycles AC. Dimensions of wooden chest 24¾" x 28⅞" x 21¼". Supplied with tubes, connecting cable, schematic diagram, etc. Shipping weight 290 lbs.

PRICE EACH, SLASHED TO **$169.50**

15-600 KC RECEIVER

Navy Model RBL, mfd. by National and Wells Gardner—(both types available) for ship and shore application. Designed for 110V. AC, 50-60 cycle operation. Receives CW, ICW and Phone signals, throughout the entire range of 15 to 600 KC in 6 bands. Employs 7 modern metal tubes in TRF circuit with regeneration, plus two audio filters to allow choice of two band widths, 600 or 3000 cycles at 20 db down with peak response occurring at 750 and 1000 cps respectively. Also incorporated audio limiter stage which reduces noise and interference. This is an excellent receiver for wireless operators, hams, and all others interested in the long and intermediate wave bands. Dim: 17⅝" L. x 15½" D. x 10½" H. (less shock mounts). Supplied complete with tubes, instruction sheets nad diagram. Shpg. wt. 135 lbs.

PRICE, EACH, Excellent—Line New Condition **$79.50**

PRICE, EACH, Used—Good Condition **$64.50**

LIMITED QUANTITY BARGAINS

GENERAL ELECTRIC 10 KW RF POWER AMPLIFIER, model BF-3A, designed to increase RF power output of FM Transmitters (88-108 mc) to 10KW. Can be modified to operate on other frequencies. Available NEW-less Rectifier Power Supply and Tubes. **EACH** ..**$795.00**

COLLINS MODEL MRF TRANSCEIVERS, covers 60 to 80 mc single channel crystal-controlled Transmitter & Receiver. Full 3 watts RF output. Ideal as 5 mc Walky-Talky. Used—Good Condition. With tubes and cable less other accessories. Operates from 110V. AC-DC. Shpg. wt. 50 lbs. **EACH** **$32.50**

3-RANGE SIGNAL GENERATOR. Well built and highly engineered, this test signal generator is a rare bargain for laboratories, service shops, and for production testing in factories. Known as the OAV-1 Test Generator, it provides any one or all of 3 outputs: (1) a V.H.F. output variable from 150 to 250 mc.; (2) a 15 mc. output (which can be changed to another nearby frequency for TV-IF alignment); and (3) Multivibrator output of .1, 1.0, 10.0 and 100 KC by means of a selector switch. Frequency stability is excellent and calibration at least as good as any excellent service signal generator. Includes following tubes 1—5Y3GT, 1—6SK7, 1—6AG7, and 2—6002. Operation is from 110 V. 60 cycles, 1-phase input. Dimensions are: L—13¼", H—13¾", D—7½". Shpg. wt. 85 lbs. NEW units, with operating instructions and Schematic.

ONLY **$24.95**

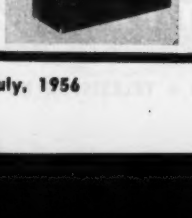
DM-37 DYNAMOTORS. Same as DM-35 Dynamotor (625 V. DC at 225 ma) but for 24 V. DC input. Excellent for pleasure boat radio power supply. Used—excellent—**EACH** **$7.45**

PE218-INVERTERS. 24-27.5 V. DC Input. 110 V. 400 cycles/1 phase, 1500 VA. Output. NEW UNITS. **EACH** **$14.95**

600 W. LOUDSPEAKER

designed for use with above Amplifier, consists of two 6-unit sections which bolt together to form 12-speaker unit shown. Dotted lines show how wooden baffle extensions may be added for improved low-frequency response. Dim. of 6-speaker section 29¼" L x 15⅝" H x 21" D. All steel construction. Uses loudspeaker units illustrated below. UNUSED. Shpg. wt. per 6-speaker section 225 lbs. **PRICE:** PER 6-Speaker section, **$75.00.**

50-60 W. SPEAKER UNIT



Western Electric Speaker units, for horn or baffleboard mtg. NEW units, removed from above speaker. Shock and blast proof diaphragm, will handle up to 60 watts. Response to 7,000 cps, favoring high freq. Impedance 13 ohms. Dim.: 6" x 6" x 4¼" deep. Throat opening—1⅛" dia. Alnico 5 slug wt. 6 lbs.

Shpg. wt. 20 lbs.

EACH, SLASHED TO **$11.95**

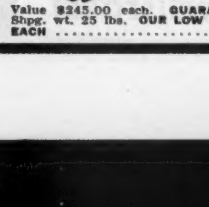
V.H.F. TEST EQPT. 150-230 MC.

A Complete Test Instrument covering 150 to 230 mc, operating from 110 V. 50/70 cycles AC, mfd. for Navy, Model OAP. See our ad in May '56 issue of RTN for illustration and full specifications. Permits following functions. (1) Tune a transmitter to given frequency. (2) Tune a receiver to a given frequency. (3) Adjust antenna system, etc. 15⅛ L. x 8½" W. x 10½" H. Includes calibration chart, separate receiver gain control, T-connector, and line cord. LIKE-NEW condition. Shpg. wt. 50 lbs. **EACH** **$49.50**

TCS ANTENNA LOADING COIL.

Used with above equipment to obtain maximum performance with short whip antenna. Has 6-position tapped switch for various lengths of antenna. In metal housing 6" H. x 9½" W. x 6¾" D. Shpg. wt. 6 lbs. **EACH** **$7.95**

SELECTIVE RINGER for MOBILE or MARINE RADIOTELEPHONES



Western Electric Model 107A, for use with Bell Telephone System for selective calling of marine or mobile radiotelephones. Alternate 600 and 1500 cycle tones, at a rate of 8 to 11 frequency shifts, actuate a selector mechanism to close a ringing or light circuit (not supplied). Dimensions of unit are: 14-1/16" long, 8¾" high, and 6-27/32" wide. DC operating voltage of from 90 to 250 V. is obtained from receiver. **NEW—UNUSED** units with Instruction Book. Reg. Value $245.00 each. **GUARANTEED SATISFACTORY!** Shpg. wt. 25 lbs. **OUR LOW PRICE** **$85.00**

EACH

All Above Material Subject to Prior Sale. 25% Minimum Deposit with All C.O.D.'s. Min. Order —$5.00. All Prices F.O.B. Our Address.

— TELEMARINE — COMMUNICATIONS CO.

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Cable Address: Telemarine N. Y.
Phone: ES 2-4300

New! SICO Streamlined TUBE TESTERS

FOR { **The Experimenter or Part-time Serviceman,** who has delayed purchasing a higher priced Tube Tester.
The Professional Serviceman, who needs an extra Tube Tester for outside calls.
The busy TV Service Organization, which needs extra Tube Testers for its field men.

Superior's New Model TC-55

• **You can't insert a tube in wrong socket.** Separate sockets are used, one for each type of tube base. • **"Free-point" element switching system** Any pin may be used as a filament pin and the voltage applied between that pin and any other pin, or even the "top-cap". • **Checks for shorts and leakages between all elements.** Provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. Continuity between various sections is individually indicated. • **Elemental switches are numbered in strict accordance with R.M.A. specification.** The 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system.

Speedy, yet efficient operation is accomplished by: Elimination of old style sockets used for testing obsolete tubes (26, 27, 57, 59, etc.) and providing sockets and circuits for efficiently testing the new Noval and Sub-Minar types.

Model TC-55 comes complete with operating instructions and charts and streamlined carrying case.

$26.95 NET

PICTURE TUBE TESTER

Superior's New Model TV-40

• **Tests all magnetically deflected tubes . . . in the set . . . out of the set . . . in the carton!!**

• **A complete picture tube tester for little more than the price of a "make-shift" adapter!!**

The Model TV-40 is absolutely complete! Self-contained, including built-in power supply, it tests picture tubes in the only practical way to efficiently test such tubes; that is by the use of a separate instrument which is designed exclusively to test the ever increasing number of picture tubes!

SPECIFICATIONS

Tests all magnetically deflected picture tubes from 7 inch to 30 inch types. • Tests for quality by the well established emission method. All readings on "Good-Bad" scale. • Tests for inter-element shorts and leakages up to 5 megohms. • Test for open elements.

Model TV-40 comes absolutely complete — nothing else to buy. Housed in round cornered, molded bakelite case. Only . . .

$15.85 NET

Superior's New Model TV-11
Standard Professional

TUBE TESTER

★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary.

★ The Model TV-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

★ Free-moving built-in roll chart provides complete data for all tubes.

★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRA SERVICE — The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

The model TV-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

$47.50 NET

TRANS-CONDUCTANCE TUBE TESTER

Superior's New Model TV-12

TESTING TUBES

★ **Employs improved TRANS-CONDUCTANCE circuit.** An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.

★ **NEW LINE VOLTAGE ADJUSTING SYSTEM.** A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 2%.

★ **SAFETY BUTTON**—protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching.

★ **NEWLY DESIGNED FIVE POSITION LEVER SWITCH ASSEMBLY.** Permits application of separate voltages as required for both plate and grid of tube under test, resulting in improved Trans-Conductance circuit.

TESTING TRANSISTORS

A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale.

Model TV-12 housed in handsome rugged portable cabinet sells for only

$72.50 NET

ALSO TESTS TRANSISTORS!

EXAMINE BEFORE YOU BUY!
USE APPROVAL FORM ON NEXT PAGE

New! SICO Superior's New Model 670-A SUPER-METER

SPECIFICATIONS

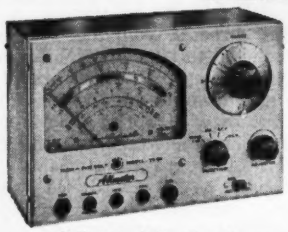
D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Good-Bad scale for checking quality of electrolytic condensers.)
REACTANCE: 50 to 2,500 Ohms 2,500 Ohms to 2.5 Megohms
INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries
DECIBELS: −6 to +18 +14 to +38 +34 to +58

ADDED FEATURE:
Built-in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

The Model 670-A comes housed, in a rugged crackle-finished steel cabinet complete with test leads and operating instructions.

$28.40 NET

SICO Superior's New Model TV-60 20,000 OHMS PER VOLT ALLMETER



Includes services never before provided by an instrument of this type. Read and compare features and specifications below!

FEATURES

- Giant *recessed* 6½ inch 40 Microampere meter with *mirrored* scale.
- Built-in Isolation Transformer.
- Use of the latest type *printed circuit* and 1% multipliers assure unchanging accurate readings.

SPECIFICATIONS

8 D.C. VOLTAGE RANGES: (At a sensitivity of 20,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500/30,000 Volts.

7 A.C. VOLTAGE RANGES: (At a sensitivity of 5,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500 Volts.

3 RESISTANCE RANGES: 0 to 2,000/200,000 Ohms, 0-20 Megohms

2 CAPACITY RANGES: .00025 Mfd. to 30 Mfd.

5 D.C. CURRENT RANGES: 0-75 Microamperes, 0 to 7.5/75/750 Milliamperes, 0 to 15 Amperes.

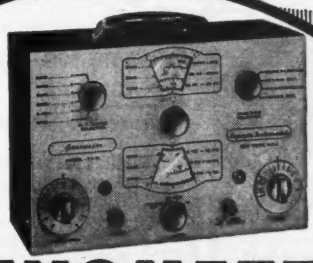
3 DECIBEL RANGES: −6 db to +58 db

RF SIGNAL TRACER SERVICE: Enables following the R.F. signal from the antenna to speaker of any radio or TV receiver and using that signal as a basis of measurement to first isolate the faulty stage and finally the component or circuit condition causing the trouble.

AUDIO SIGNAL TRACER SERVICE: Functions in the same manner as the R.F. Signal Tracing service specified above except that it is used for the location of cause of trouble in all audio and amplifier systems.

Model TV-60 comes complete with book of instructions; pair of standard test leads; high-voltage probe; detachable line cord; R.F. Signal Tracer Probe and Audio Signal Tracer Probe. Pliofilm bag for all above accessories is also included. Price complete. Nothing else to buy. ONLY

$52.50



SICO Superior's New Model TV-50 GENOMETER

A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

A.M. Radio • F.M. Radio • Amplifiers • Black and White TV • Color TV

R. F. SIGNAL GENERATOR: Provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics. • **VARIABLE AUDIO FREQUENCY GENERATOR:** In addition to a fixed 400 cycle sine-wave audio, the Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal. • **BAR GENERATOR:** Projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars. • **CROSS HATCH GENERATOR:** Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect. • **DOT PATTERN GENERATOR (FOR COLOR TV):** The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for proper color convergence. • **MARKER GENERATOR:** The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency.)

MODEL TV-50 comes absolutely complete with shielded leads and operating instructions.

Only **$47.50 NET**

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TRY ANY of the instruments on this page, for 10 days before you buy. If completely satisfied ***then*** send down payment and pay balance as indicated on coupon. ***No Interest or Finance Charges added!*** If not completely satisfied return unit to us, no explanation necessary.

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- ☐ Model TV-12.....Total Price $72.50 $22.50 within 10 days. Balance $10.00 monthly for 5 months.
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- ☐ Model TV-40.....Total Price $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.
- ☐ Model TV-50.....Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.
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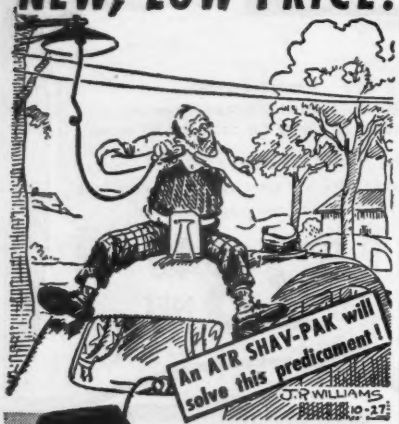
NEW, LOW PRICE!



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Plugs into Cigarette Lighter Receptacle on Dash

$11.95 LIST PRICE

Specially Designed for Operating Standard A.C. Electric Shavers in Automobiles, Buses, Trucks, Boats, and Planes.

TYPE	INPUT D.C. VOLTS	A.C. OUTPUT 60 CYCLES	OUTPUT WATTAGE	LIST PRICE
6-SPB	6	115 volts	15	11.95
12-SPB	12	115	15	11.95

Introducing
ATR MIGHTY MIDGET portable INVERTER
WITH GREATER OUTPUT

DICTATE REPORTS ACCURATELY-PROMPTLY!

make your car, boat or plane a "rolling office" with ATR INVERTERS

for changing your storage battery current to A. C. Household ELECTRICITY Anywhere in your own car!

Plugs into Cigarette Lighter Receptacle on Dash

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ATR INVERTERS . . .
especially designed for operating standard 110 volt A. C. . . .

• DICTATING MACHINES • TAPE RECORDER
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TYPE	INPUT D.C. VOLTS	A.C. OUTPUT 60 CYCLES	OUTPUT WATTAGE	LIST PRICE
6-DME	6	115 volts	30-40	19.95
6H-DME	6	115 volts	60-75	29.95

Above Inverters also available for 12-volt operation.

See your jobber or write factory today for complete information

ATR AMERICAN TELEVISION & RADIO CO.
Quality Products Since 1931
SAINT PAUL 1, MINNESOTA—U. S. A.

TV Programs on Magnetic Tape

Newly developed system permits up to one hour of program material to be recorded on a single 14-inch reel of tape.

A NEW process for recording and reproducing TV programs on magnetic tape has been publicly demonstrated by *Ampex Corporation* of Redwood City, Cal.

The new video recorders, several of which have been ordered by the major television networks, operate at 15 ips and provide a full hour of television program on 14" reels of 2" magnetic tape.

The system records both picture and sound on a single magnetic tape 2 inches wide. The picture quality is said to be considerably better than that obtained with current kinescope techniques using photographic film. The "gray scale" (the ability to reproduce accurately all shades from black to white) is uniform in this new system. On the other hand, the gradient from black to white is not uniform in photographic film, the company noted.

The resolution of the new system is said to be beyond the capability of the average television receiver. Thus, when a tape recorded program is telecast, the limitation of picture quality will be in the home receiver rather than in the quality of transmission. The maximum number of lines a TV station can transmit is 340. The new tape recorder will record and reproduce more than 320 lines.

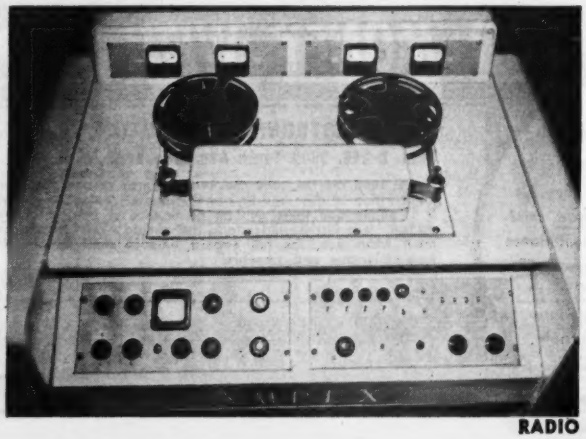
With the new system, programs can be recorded directly from the TV camera, from a TV receiver, from TV transmission lines, or from microwave relay systems. The program can then be immediately replayed without processing of any kind. The tape can be erased and re-used, if desired.

One of the most interesting features of this new equipment is the type and operation of the heads. Electrical signals are passed through a coil around an electromagnet (the recording head) with the strength of the magnetic field in the recording head dependent on the electrical current in the coil at a given instant. In turn, the magnetic field impresses a pattern on the magnetic surface of the tape as it passes the recording head. The pattern on the tape thus corresponds to the electrical signals in the coil on the recording head. Since these signals are generated by the TV camera, the pattern on the tape corresponds to what the camera "sees."

To reproduce the picture, the tape is passed across the same magnetic head. The magnetic pattern on the tape induces a current in the coil around the head. Since the pattern corresponds to the original picture, the induced current can be fed to a TV transmitter just as though it were coming directly from the TV camera.

To obtain the 4 mc. response needed for video recording, theoretically the tape speed would have to be 2000 ips. At that rate, a reel of magnetic tape 14" in diameter would record only 29 seconds of program material.

In order to cope with this problem *Ampex* engineers have developed a system which permits a tape speed of only 15 ips, yet allows a full hour's program to be recording on a single 14" reel. To achieve this relatively slow tape speed, a magnetic head assembly which rotates at a high speed is used, giving an effective tape speed sufficient to record and reproduced the full 4-mc. bandwidth. Thus, while the tape moves slowly, the heads move across the surface of the tape at a very high speed. The head assembly actually consists of four heads placed on a rotating drum. One head is always in contact with the surface of the tape. As one head leaves the tape, the next head makes contact. The magnetic pattern is recorded transversely across the tape instead of longitudinally as in conventional audio recorders. The sound that accompanies the picture is recorded in the ordinary manner along one edge of the magnetic tape. —30—



Top view of the Ampex tape recorder for TV. The special tape for this unit is 2 inches wide and both video and audio portions of the program are recorded on the one tape. Despite the number of controls, recording and playback involve the pushing of only one button for each operation.

LIFETIME GUARANTEED TUBES

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PICTURE TUBES

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- One Year Unconditional Guarantee

Type	Price	Type	Price
10BP4	$11.90	17BP4	$20.63
12LP4	$14.38	19AP4	$24.81
14BP4	$16.86	21AP4	$28.79
16RP4	$19.38	21EP4	$28.79
16LP4	$19.38	24AP4	$42.50

Picture Tubes shipped F.O.B. Harrison, N. J.
Above types are most popular. However, you may order any equivalent size at the same price.

NEW INDOOR ANTENNA

Both UHF and VHF. Brings better reception than most outdoor antennas. Use on top of TV.

List Price $9.95

Your Price

Lots of 3 $3.29

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Table Model . . . $22.95
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16" SET
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FREE BONUS BOX With Every $25 Order

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- 10 Assorted 2 color "blank" tube cartons
- 1 6BQ6GT tube
- 1 6AU6 tube
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FREE CLOCK RADIO

With Every $125 Purchase Within 30 Days

Wakemaster clock radio with famous Sessions clock movement wakes you to music or alarm. May be purchased outright from MAJOR BRAND for $17.95. In ivory or rust.

FREE GIFT CERTIFICATE* worth $5 toward the purchase of any of our merchandise on future orders will be sent with any order of $50 or more.

* Free Gift Certificate cannot be used to obtain another certificate unless order is $55 or more.

HERE'S HOW LIFETIME GUARANTEED TUBES SAVE YOU MONEY!

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- Each Tube Individually Boxed and Guaranteed
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- Immediate Shipment
- Free Postage On All Orders With Full Remittance
- There are fewer "call backs"
- There are no "out of date" tubes
- "Peak Performance" testing in our fully equipped Testing Department before shipment guarantees quality

0Z4	.43	6A7	.57	6K6GT	.37	12AV6	.35
1A7GT	.43	6A8	.45	6K7	.39	12AV7	.67
1A7G7	.43	6AB4	.43	6K8	.65	12AX4GT	.65
1B3GT	.65	6AC7	.67	6L6	.68	12AX7	.58
1C5GT	.41	6AF4	.79	6L7	.42	12AZ7	.63
1D5GP	.43	6AG5	.50	6N7	.60	12B4	.68
1E7GT	.41	6AG7	.69	6Q7	.40	12BA6	.46
1G6GT	.41	6AH6	.69	6S4	.40	12BD6	.48
1H4G	.43	6AJ5	.70	6SA7	.45	12BE6	.46
1H5GT	.47	6AK5	.54	6SC7	.48	12BH7	.60
1J6GT	.47	6AL5	.39	6SG7	.41	12BY7	.65
1L4	.45	6AQ5	.46	6SH7	.43	12BZ7	.61
1L6	.55	6AR5	.46	6SJ7	.43	12CU6	.95
1LA4	.57	6AS5	.48	6SK7	.45	12SA7	.45
1LA6	.47	6AS6	1.70	6SL7GT	.55	12SJ7	.45
1LB4	.57	6AS7G	2.19	6SN7GT	.55	12SK7	.45
1LC5	.49	6AT6	.39	6SQ7	.39	12SN7GT	.55
1LC6	.47	6AU4GT	.65	6SR7	.42	12SQ7	.37
1LD5	.57	6AU5GT	.59	6SS7	.41	12SR7	.45
1LE3	.57	6AU6	.42	6T4	.95	12V6GT	.45
1LG5	.57	6AV5GT	.65	6T8	.68	12X4	.37
1LH4	.64	6AV6	.39	6U8	.75	14A7	.42
1LN5	.47	6AX4GT	.60	6V3	.80	14B6	.38
1N5GT	.50	6AX5GT	.57	6V6GT	.46	14Q7	.50
1R5	.50	6B4G	.82	6W4GT	.39	19BG6G	1.15
1S5	.42	6B8	.69	6W6GT	.53	19T8	.65
1T4	.50	6BA6	.47	6X4	.34	24A	.39
1U4	.47	6BA7	.58	6X5	.34	25AV5GT	.78
1U5	.42	6BC5	.47	6X8	.73	25BQ6GT	.78
1V2	.65	6BC7	.80	6Y6G	.55	25L6GT	.47
1X2	.61	6BE6	.45	7A4	.45	25W4GT	.43
2A3	.55	6BF5	.40	7A5	.53	25Z5	.37
2A5	.57	6BF6	.50	7A6	.55	25Z6	.37
2A7	.55	6BH6	.50	7A7	.43	27	.25
3A4	.51	6BJ6	.47	7A8	.45	35A5	.46
3A5	.50	6BK5	.68	7B5	.39	35B5	.50
3AL5	.45	6BK7	.76	7B6	.42	35C5	.50
3AU6	.46	6BL7GT	.75	7B7	.41	35L6GT	.47
3BC5	.54	6BN6	.58	7B8	.45	35W4	.34
3BN6	.70	6BQ6GT	.78	7C4	.39	35Y4	.34
3CB6	.52	6BQ7	.78	7C5	.42	35Z3	.39
3Q4	.46	6BY5G	.58	7C6	.43	35Z5GT	.34
3Q5GT	.57	6BZ7	.88	7C7	.45	37	.29
3S4	.47	6C4	.37	7E5	.45	50A5	.46
3V4	.47	6C5	.35	7E6	.55	50B5	.50
4BQ7	.89	6CB6	.49	7E7	.70	50C5	.50
4BZ7	.95	6CD6G	1.15	7F7	.59	50L6GT	.43
5AW4	.75	6D6	.48	7F8	.70	75	.42
5BG6G	1.15	6E5	.44	7G7	.75	76	.42
5J6	.63	6F5	.37	7H7	.50	77	.38
5T4	.69	6F6	.38	7J7	.75	78	.38
5U4G	.43	6G6	.40	7K7	.75	80	.34
5U8	.74	6H6	.38	7L7	.75	84/6Z4	.44
5V4G	.59	6J4	1.79	7N7	.50	117L7GT	1.09
5Y3	.31	6J5	.39	12AT6	.37	117N7GT	1.09
5Y4G	.36	6J6	.47	12AT7	.66	117P7GT	1.09
5Z3	.41	6J7	.43	12AU6	.41	117Z3	.35
		6J8G	.85	12AU7	.53	117Z6GT	.63

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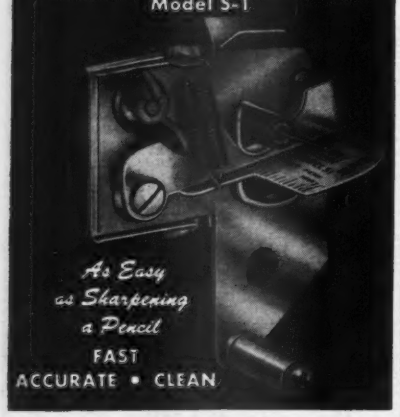

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- Cuts and strips the outer covering of coax cable without injuring the shielding.
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Single-Sideband

(*Continued from page* 57)

distort the quality of the audio intelligence. The total input power required from the prime source of power, whether batteries, motor-generator, etc., is considerably less for the SSB system than for a comparable AM system. For transmitters in the region of 100 to 1000 watts in peak envelope output power, the input a.c. power of the SSB system will, in general, be 25% to 50% that of the AM system. The advantage to a mobile station (airborne or mobile-marine) is rather obvious.

The physical size and weight will be considerably less in the SSB case. This, in many instances, will be a factor of from two to four times between the two systems. This matter of power consumption and weight is of particular importance in airborne communication equipment applications.

It is believed that conversion of an AM radio telephone system to SSB can only be appreciated by the user when operation of such a system involves signals which are weak and near the ambient noise level. It will then be apparent that signals that are only slightly above the receiver noise level will be completely intelligible whereas with the conventional AM-type of transmission it might only be possible to detect the carrier signal with a beat frequency oscillator.

Conclusions

Just as surely as night follows day single-sideband will supplant practically all of the AM radiotelephone systems now in use. There will undoubtedly be reaction in some circles against this new mode of transmission. This is to be expected—it is human nature. Progress will be made in spite of ourselves. History has proven this many hundreds of times. Despite the added complexity and considerably different techniques of single-sideband the average technician and user can become accustomed to them and will learn in a very short time to appreciate the several advantages. There will shortly be many reputable manufacturers offering single-sideband gear to the commercial users. Look over the market and make your choice carefully. See you on single sideband!

REFERENCES

1. The Product Detector; "Single Sideband for the Radio Amateur," published by the ARRL, West Hartford, Conn.
2. Panoramic Radio Products, Inc., 10 S. Second Ave., Mt. Vernon, N. Y.
3. Berkeley Division, Beckman Instruments, Inc., 2200 Wright Ave., Richmond, California.
4. Hewlett-Packard Co., 3636A Page Mill Road, Palo Alto, California.

—30—

A TWO-TRANSISTOR BROADCAST RECEIVER

MANY readers have expressed an interest in a pocket broadcast receiver using transistors. One recently released circuit, which calls for two readily available transistors, may meet these readers' requirements and is, therefore, reproduced here.

By using subminiature parts and assembling the unit with great care, the entire receiver can be built into a plastic box measuring a mere 2½" wide, 2½" long, and 1¼" deep. The box should be of the type that opens at the top to facilitate mounting of the components. The tuning capacitor, "Loopstick," pin jacks, and transistors are all installed in the bottom of the case as are the batteries and their holder.

The circuit is a regenerative type. Feedback is from the collector to the emitter. Since the emitter circuit impedance is very low, the fixed capacitor and "Loopstick" are placed in the collector circuit. Here the impedance is moderately high. The tickler winding feeds the emitter. In order to permit the transistor to oscillate and still detect the signal, a separate 1N34A diode rectifier is used.

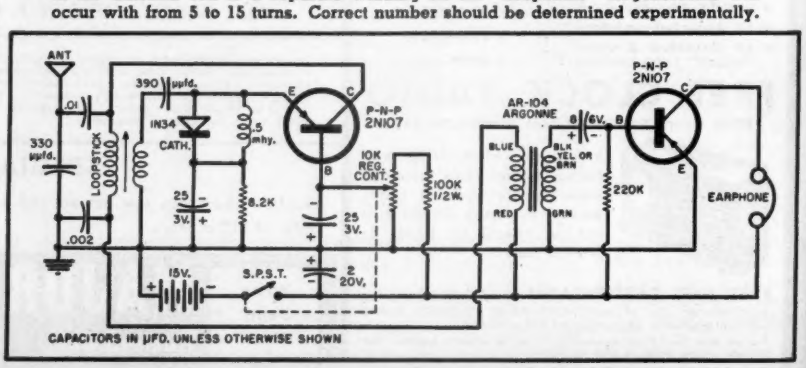
The circuit can be used with either crystal or dynamic earphones. If a crystal earpiece is used, a 4700-ohm resistor should be connected across the output lugs to which the earphone is connected. If the dynamic earphone is used the resistor must be omitted.

The transformer used in this circuit is a special miniature transistor unit made by Argonne Electronics Mfg. Corp., available at jobbers as the AR-104.

Those who prefer to buy all of the parts from a single source can obtain a kit from Lafayette Radio, 100 Sixth Ave., New York 13, New York for $11.80 (less earphone). It is catalogued as the KT-68.

—30—

Schematic of a two-transistor broadcast-band miniature receiver. The "secondary" of the antenna coil is a separate winding on the "Loopstick." Regeneration will occur with from 5 to 15 turns. Correct number should be determined experimentally.



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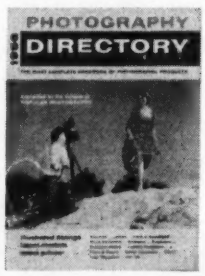

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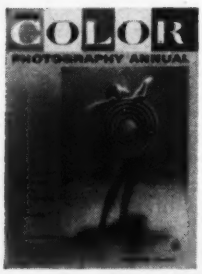

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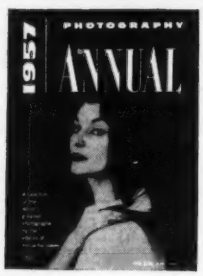

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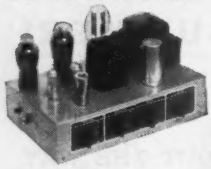
Bass and Treble Tone Controls
Input for Xtal or Dynamic Mike
Input for Xtal or V.R. Phono



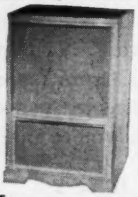
Model HF-20

With CU-14Y, 12" Coax Speaker...$32.95
With P15-CR, 15" Coax Speaker...$42.95
With Imperial IV System.....$39.95
With SP-12125CR.....$44.95 With HF-33GE $69.95

A tremendous High Fidelity amplifier value. Response 30 to 15,000 cps. Electronic bass and treble boost by separate tone controls. Use this amplifier with any record changer having crystal or variable reluctance cartridge, radio tuner or high impedance crystal or dynamic microphone. 20 watts power output. Use with any 4 or 8 ohm speaker or 250 ohm line. Chassis size, 7⅜" x 10½" x 7½" high. Complete with tubes: 2—6L6, 2—6C4, 12AX7 and 5U4G. This is a terrific value. A ready to use high fidelity amplifier at less than the cost of a kit. Ship. wt. 17 lbs. Model HF-20, 20 watt Hi-Fi amplifier. McGee's sale price, $22.95.

CONSOLE HI-FI SPEAKER SYSTEM $49.95

12" G.E. PM WOOFER—10" PM MID-RANGE—8" G.E. MODEL 850 MID-HIGH RANGE SPEAKER AND 600 CYCLE L-C CROSSOVER NETWORK.



Have Juke Box tone quality in your own home. Strictly High fidelity. Three speakers all connected to a 600 cycle frequency dividing network, so that only 2 wires lead to any system from any 4 or 8 ohm radio or amplifier. A variable tone compensating control incorporated in the circuit makes brilliant highs or boomy lows to your own taste. Any amplifier that you now have will give you a much wider selection of acoustical arrangements with this speaker system. The 3-way system is shipped ready to connect to your amplifier or hi-fi radio. Equipped with a General Electric 12" woofer, an 8" famous G.E. 850 plus a 10" middle range speaker. Frequency response 30 to 15,000 cps. Take your choice of cabinets; blonde oak, walnut or mahogany. (Specify finish desired when ordering) 37" high, 24" wide and 20" deep. Ship. wt. 75 lbs. Stock No. HF-33GE. Sale price, $49.95.

Model HF-44GE, console speaker system, same as above except has a heavy duty 12" G.E. PM Model 1201, plus 8" G.E. PM Model 850, 10" mid-range speaker and 5" hard cone tweeter. Sale price, $54.95. (Specify cabinet finish.)

Model HF-55GE, super deluxe quality console speaker system, same as HF-33GE described above, except has 15", 21 oz. Alnico V magnet woofer, 10" mid-range PM speaker and Model 4401 University horn type tweeter. All 3 systems incorporate 600 cycle L-C type crossover network with variable tone compensating control. Model HF-55GE. Sale price $69.95 (specify cabinet finish).

DELUXE CONSOLE SPEAKER SYSTEM $89.50

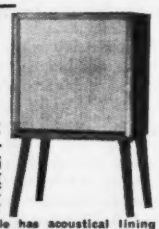
15" UTAH WOOFER—8" GE—2 - 5" TWEETERS—CROSSOVER

New, deluxe quality High-Fidelity console speaker system. Has 15" Utah woofer with 21 oz. Alnico V magnet, 8" model 850 G.E. mid-range speaker and two Utah 5" tweeters. This is the finest console speaker system that we offer. Available in blond oak or natural mahogany finish. Cabinet size, 43" high, 31" wide and 23" deep. Has ¾" length doors with attractive hardware and ornament on grill below doors. All 4 speakers are connected to a 600 cycle frequency dividing network, so that there are only 2 wires to connect to any 4 or 8 ohm output of your radio or amplifier. Has variable tone compensating control built-in. Model HF-15CR4, deluxe quality Hi-Fi console speaker system. Ship. wt. 150 lbs. (Specify cabinet finish desired.) Sale price, $89.50.

NEW 15" COAXIAL IMPERIAL SPEAKER SYSTEM

SALE PRICE $34.95

20 to 17,500 CPS
BUILT-IN CROSSOVER
CHOICE OF BLOND, MAHOGANY OR MAPLE



Imperial Model 15-BF speaker system. Choice of blond, mahogany or maple finish cabinet. Baffle is equipped with a 15 watt, 15" coaxial, high fidelity PM speaker with coaxially suspended 5" tweeter. Built-in crossover connects the tweeter electrically to the woofer. Only 2 wires to connect to any 8 ohm output from your high fidelity amplifier. Ideal for use with our Imperial 30 or HF-20 amplifiers described above. Frequency response down to 20 cps and up to 17,500 cps. Baffle is 23" high, 26" wide and 21" deep. Overall height is 40". Baffle has acoustical lining for fine musical reproduction. This speaker system compares with units selling for $100.00. Stock No. IMP-15BF, 15" coaxial speaker and baffle. Ship. wt. 53 lbs. Sale price, $34.95. Specify cabinet finish; blond, mahogany or maple when ordering. Stock No. IMP-XPR, speaker system same as above, except equipped with our P15-CR, 15" coaxial PM speaker described on opposite page. Sale price, $39.95.

THEATER QUALITY HIGH FIDELITY SPEAKER SYSTEM $39.95

15" WOOFER PLUS—ELECTROVOICE MODEL 847 MID-HIGH RANGE SPEAKER — 600 CYCLE LC CROSSOVER.

A theatre quality, powerful speaker system for homes and sound demonstration rooms. This speaker arrangement will connect to any high fidelity audio amplifier (8 ohms impedance) Features a 15" electro-dynamic heavy duty woofer which is equal to a PM speaker with up to 10 lbs. of Alnico V magnet. This woofer reproduces the low audio register from 600 cycles down to 20 cps. An Electro-Voice Model 847 horn type speaker is used for the middle range and high range of audio. These two speakers are connected to a 600 cycle inductive-capacity crossover network. Built in the network is the field exciter for the 15" woofer. You could spend over $100 for a speaker system and not beat this one. Stock No. EV-15847X, McGee's sale price, $39.95.

NEW IMPERIAL SPEAKER SYSTEMS

Imperial IV with 8" G.E. High Fidelity Speaker
$19.95

3-Way Imperial VI with 12" G.E. Speaker
$29.95

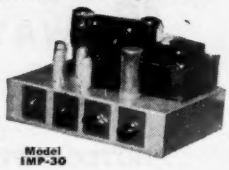
New 1957 Model IMPERIAL IV, High fidelity speaker system with General Electric 8" speaker. Housed in a high quality leatherette covered plywood cabinet 10" x 10" x 24" long. Fully enclosed; covered on all sides except back. Use as an auxiliary speaker or with any high fidelity radio, amplifier or home music system. The IMPERIAL IV contains a General Electric Woofer for extended range high fidelity 8" PM speaker with 6.8 oz. Alnico V magnet and curvelinear cone with 8 ohm voice coil and a 3" tweeter. Response 50 to 15,000 cps. Model IV Imperial $19.95.

1957 Model Imperial VI, 3-way speaker system. Baffle is of heavy wood, leatherette covered. Similar in appearance to the Imperial IV pictured above, except 4" taller and 1" deeper. Equipped with 3 matched speakers. A 12" G.E. Model 1203 with 9 oz. Alnico V magnet, plus 5¼" PM for middle range and 3" tweeter. Simple to connect to any high fidelity amplifier. (8 ohms impedance). Stock No. IMP-VI, Sale price, $29.95. Ideal for use with HF-20 and IMP-30 amplifiers described above.

IMPERIAL 30 WATT AMPLIFIER $29.95

NEW 1957 MODEL

Push-Pull 6L6 Output Tubes
Response 15-20,000 CPS
Bass and Treble Tone Controls
Compensated Gain for G.E. Cart.
Input for Xtal or Dynamic Mike



Model IMP-30

With CU-14Y, 12" Coax Speaker .$39.95
With P15-CR, 15" Coax Speaker..$49.95
With Imperial IV Speaker System..$46.95
With SP12125CR .....$51.95 With HF-33GE $76.95

New 1957 model 7 tube Imperial 30 watt High Fidelity audio amplifier. A $100.00 list value for only $29.95. Features a heavy 4 lb., specially wound high fidelity output transformer with 15% inverse feed-back, push-pull 6L6 output tubes and frequency response from 15 to 20,000 cps. Matches 8 or 16 ohm speakers. You can center your entire custom music system around this low cost 30 watt amplifier. This Imperial 30, 30 watt amplifier may be used with any radio tuner or record player. It will drive any speaker system that you may have. Use from one to ten 8" speakers or any 12" or 15" coaxial speaker or any 3-way speaker system. Tone compensated input for either a crystal phono pickup or a General Electric variable reluctance pickup. Also, has input for crystal or high impedance dynamic microphone. 4 controls are mike gain, phono gain, treble tone and bass boost tone control. This amplifier weighs 21 lbs. net. Full size transformer components would cost you up to $15.00 if purchased separately. Gold color chassis is 12¼" x 7¾" x 7¼" high. Complete with tubes: 6AT6, 12AU7, 6C4, 12AU7, 2 for only $24.95. Frequency response 20 to 18,000 cps. Both the woofers and the tweeters are fine quality dynamic speakers with fields excited to saturation by the power supply. Tweeters are specially made with cones designed to respond only to the high frequencies of the audio spectrum. The 2000 cycle cross-over network is of the high quality inductance-capacitance type which prevents frequencies below 2000 cps from entering the tweeters and eliminates frequencies above 3000 cps from the woofer circuit. The cross-over network system is simple to connect to any 4 or 8 ohm output of your high fidelity audio amplifier or radio. No. SP-12125CR, High Fidelity Dynamic Speaker System. Ship. wt. 15 lbs. Sale price, $24.95.

No. SPS-12125, High Fidelity Dynamic Speaker System, as described above, but less the 2000 cycle cross-over network and with a separate attenuator control. Sale price, $14.95. Ideal for use with HF-20 and IMP-30 amplifiers described above.

Stock No. 27-MA. Mahogany with full doors for 21", 24" and 27" TV. 43" h. 30¼" w. 23" deep. Chassis area 27¾" w. 25" h. 18¼" deep. Baffle for 10" speaker. A beautiful cabinet that cost the factory over $100. Made for a $600 TV set. Ship. wt. 135 lbs. Sale price, $59.95. Blank panel $5.00 extra. Shipped with 27" mask and safety glass.

25 WATT HI-FI SPEAKER SYSTEM

2-12" Woofers
2-5" Tweeters
Power Supply and L-C Cross-over Network

SALE PRICE $24.95

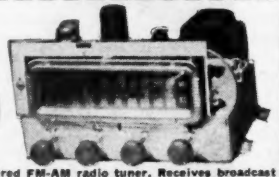
25 watt, High-Fidelity Dynamic Speaker System, complete with 2000 cycle genuine inductance-capacitance cross-over network, two 12" woofer speakers, two 5" high frequency tweeter speakers and separate 110 volt AC power supply. Tweeters are specially made with cones designed to respond only to the high frequencies of the audio spectrum. The 2000 cycle cross-over network is of the high quality inductance-capacitance type which prevents frequencies below 2000 cps from entering the tweeters and eliminates frequencies above 3000 cps from the woofer circuit. The cross-over network system is simple to connect to any 4 or 8 ohm output of your high fidelity audio amplifier or radio. No. SP-12125CR, High Fidelity Dynamic Speaker System. Ship. wt. 15 lbs. Sale price, $24.95.

AIR KING FM-AM TUNER

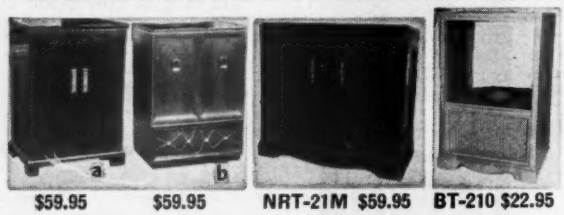
SELF POWERED

Use with ony Audio Amplifier

SALE PRICE $24.99



Air King factory built, 6 tubes self-powered FM-AM radio tuner. Receives broadcast 540 to 1620 kc and FM 88 to 108 mc. Use with any Hi-Fi audio amplifier or connect it to your TV set for FM-AM reception. Selector switch has 4 positions for TV-Phono-FM and AM. 3 other controls are volume-off-on, tone and tuning. With tubes: 12AT7, 2—6AU6, 6AL5, 6SQ7, and 5Y3 rectifier. Chassis size, 11½" x 7½" x 6¼" high. Illuminated slide rule dial 7½" x 2½", with escutcheon plate and knobs. Self-powered with its own power transformer. Air King FM-AM tuner chassis No. 703 as used in Air King model 17K1C combination TV-Radio-Phono with power supply added. Note: A separate audio amplifier is required to operate a speaker. Stock No., AIR-K6, self-powered FM-AM tuner, complete with tubes, knobs and diagram. Ship. wt. 10 lbs. Sale price, $24.99.



$59.95 $59.95 NRT-21M $59.95 BT-210 $22.95

27" Mahogany Full Door Cab. $59.95

(a) No. 27-MA. Mahogany with full doors for 21", 24" and 27" TV. 43" h. 30¼" w. 23" deep. Chassis area 27¾" w. 25" h. 18¼" deep. Baffle for 10" speaker. A beautiful cabinet that cost the factory over $100. Made for a $600 TV set. Ship. wt. 135 lbs. Sale price, $59.95. Blank panel $5.00 extra. Shipped with 27" mask and safety glass.

27" ¾ Door Mahogany Cab. $59.95

(b) No. 27-34MA. Mahogany with ¾ doors for 21", 24" and 27" sets. 43" h. 31½" w. 22¾" deep. Chassis area 27½" w. 26¾" h. 21" deep. Baffle cut for 2 10" speakers. Made for one of America's largest TV builders. Cost over $100. Ship. wt. 135 lbs. Sale price, $59.95. Blank panel $5.00 extra. Shipped with 27" mask and safety glass.

DELUXE 21" MAHOGANY TV-PHONO CABINET

No. NRT-21M, DeLuxe piano finish mahogany combination radio-phono-TV cabinet for 20" or 21" TV chassis. Beautiful full door style with matching front panels. 37" high, 40½" wide and 22¾" deep. Baffle cut for a 12" speaker. TV chassis area 21" high, 23½" wide and 19" deep. Changer shelf 15" x 17" with 9" height clearance. Ship. wt. 165 lbs. No. NRT-21M, mahogany cabinet, sale price, $59.95. 21" mask and safety glass, $6.95 extra.

21" BLONDE $22.95—MAHOGANY OR WALNUT $19.95

No. BT-210, blonde oak 21" TV cabinet. 37½" high, 24" wide and 20½" deep. TV chassis area 20½" high, 23½" wide and 18½" deep. Baffle cut for 10" speaker. Open front, no blank panel furnished. Shipping weight 68 lbs. Sale price, $22.95.

No. WT-210, walnut 21" TV cabinet, same as above. Sale price, $19.95.

No. MT-210, mahogany 21" TV cabinet, same as above, Sale price, $19.95.

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1903 McGEE ST., KANSAS CITY, MISSOURI

$100.00 VALUE 1957 MODEL — 25 WATT 6-110 VOLT PUBLIC ADDRESS AMPLIFIER — $69.95

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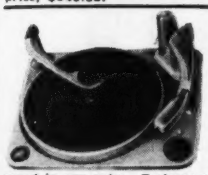
COMPLETE 25 WATT, 6-110 VOLT P. A. SYSTEM

AMPLIFIER, MICROPHONE 2-TRUMPETS (AS ILLUSTRATED) — **SALE PRICE $149.95**

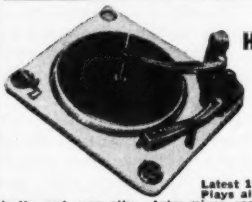
MG-625S, complete 25 watt, 6 volt DC and 110 volt AC sound system. Includes 2 model 848 Electro-Voice CDP coaxial horn projectors with drivers, a 25 watt push-pull 6L6, 6-110 volt amplifier, plus a $24.50 list Turner high impedance dynamic hand mike with off-on switch. McGee's special sale price, $149.95. Amplifier is not a kit, but our latest 1957 model, 25 watt 6-110 volt amplifier that operates equally well on a 6 volt storage battery or 110 volts AC. Amplifier features push-pull 6L6 output tubes, inputs for two high impedance mikes, 3 speed phono with crystal pickup built-in top. Phono top is packed separately for shipment. Only a few minutes required to plug-in phono and attach top cover to amplifier. Amplifier size, 13½x10x9½" high. Stock No. MG-625 amplifier only. A $100.00 net value, Sale price, $69.95. Complete 6-110 volt system as described above. Stock No. MG-625S complete with 2 Model 848 Electro-Voice speakers and Turner mike, Sale price, $149.95.



NEW IMPORTED MONARCH HIGH FIDELITY AUTOMATIC CHANGER

WITH GOLDRING #500 VAR. REL. CARTRIDGE — **SALE PRICE $29.95**

Monarch Model UA6U—new, imported high fidelity 3 speed automatic record changer. Plays 7", 10" and 12" records automatically. Intermixes records of the same speed in any order. Features a 4 pole high fidelity motor eliminating rumble and wow. Pickup automatically returns to rest and motor turns off after last record has played. Full size 10" turntable has molded rubber pallet for better record cushioning. Base size, 10⅞"x12¾". Tone arm is counter balanced to assure minimum record wear. The changer features, at no added cost the regular $9.90 net value Goldring 500 variable reluctance cartridge for the finest high fidelity record reproduction. Output 10 millivolts. Response, 20 to 16,500 cps. It requires the same input gain as popular American made variable reluctance cartridges. Model UA6U. Monarch automatic changer with Goldring cartridge, ship. wt. 15 lbs. Sale price, $29.95; Large spindle for 45 RPM records, $1.88 extra.



NEW 4 SPEED COLLARO HIGH FIDELITY RECORD CHANGER

MODEL RC-456 LESS CARTRIDGE — **$29.95**

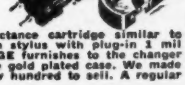
WITH G.E. VAR. REL. CARTRIDGE AND DIAMOND 1 MIL-SAPPHIRE 3 MIL STYLUS — **$44.95**

Latest 1957 Model RC-456, Collaro 4 speed record changer. Plays all 4 speeds, 16, 33, 45 and 78 RPM both automatically and manually. Inter-mixes records of the same speed and shuts-off after last record. Fast 6 second change cycle. Automatic disengagement of idler wheels eliminates flat spots that cause wow and flutter. All of the desirable features of the Model RC-532, plus 4 speed operation. Model RC-456 Collaro 4 speed automatic record changer, less cartridge. Sale price, $29.95. RC-456 with G.E. variable reluctance cartridge with 3 mil sapphire and 1 mil diamond stylus, Sale price, $44.95.

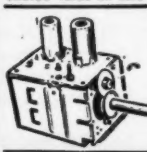
NEW CHROME WEBCOR CHANGER WITH RPX-050 G.E. VAR. REL. CART. — **$34.95**

New Webcor model 1121-270, chrome plated, 3 speed automatic record changer with RPX-050 General Electric variable reluctance cartridge. Has heavy 4 pole motor. Plays all 3 speeds and all 3 sizes. Shuts off automatically after last record. Has neutral position to prevent damaging of drive wheels. Chrome plated. Size 12x13½". Requires 2½" below and 6" above mounting board. Shipping wt. 15 lbs. Only a few to sell at this low price of $34.95.

G.E. VR CARTRIDGE WITH DIAMOND 1 MIL STYLUS SIMILAR TO RPX-052A — **$15.95**



Stock No. VR-52A, genuine General Electric variable reluctance cartridge similar to RPX-052A Golden Treasure model. Has new turnabout baton stylus with plug-in 1 mil diamond and 3 mil sapphire styles. This is the model that GE furnishes the changer manufacturers and it has a stainless steel case instead of the gold plated case. We made a terrific purchase and pass the saving on to you. Only a few hundred to sell. A regular $23.00 value on sale at McGee for only $15.95.



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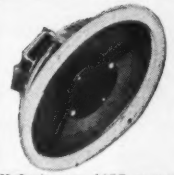
New 1957 Model GPA-30X, 30 watt amplifier for 110 volt operation with 2 Electro-Voice Model 848, 30 watt hi-fi outdoor-indoor speakers and a Turner high impedance dynamic hand mike with off-on switch. A $150.00 dealer net value on sale at McGee for only $109.95. Amplifier features push-pull 6L6 output tubes, output matches 4, 8, 16 and 500 ohm line. High fidelity response, separate base and treble tone controls, inputs for two crystal or dynamic high impedance mikes, plus crystal phono pickup. Chassis size, 7½x12"x8" high. Use for all public address needs. Priced with tubes: 2-6L6GB, 5U4G, 2-6C4, 12AX7 and 6AU6. Full 200 mil power supply components. This amplifier compares with amps selling for $60.00 to $80.00 dealers net. System furnished with two Electro-Voice Model 848, 30 watt trumpets and drivers, plus a regular $24.50 list Turner dynamic hand mike. McGee offers you this $150.00 value for only $109.95. Stock No. GPA30-848 complete P.A. system.

Model GPA-30X, 30 watt amplifier only, Sale price, $39.95.

Stock No. GPA50-848, complete 50 watt P.A. system similar to above, but with 50 watt amplifier, two Electro-Voice 848 trumpets and drivers and $24.50 list Turner dynamic hand mike with off-on switch. Sale price, $129.95.

Model GPA-50X, 50 watt amplifier only, Sale price, $89.95.

NEW 1957 MODEL



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- ★ BUILT-IN CROSSOVER—
- ★ ALUMINUM VOICE COIL WOOFER—

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McGee's Famous 12 AND 15 INCH COAXIAL P.M. HIGH FIDELITY SPEAKERS

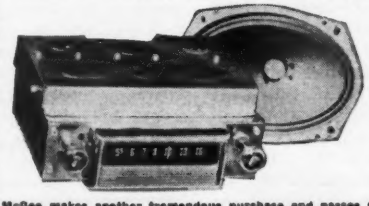
$12.95 12-Inch Model CU-14Y — **$23.95** 15-Inch Model P15-CR

Model CU-14Y, 12" high fidelity coaxial PM speaker. Response from 30 to 17,500 cps. Full 6.8 oz. Alnico V magnet in the 12" woofer. Special coaxially suspended high frequency tweeter. Built-in crossover network. Only two wires to connect to your radio or amplifier. Matches 3.2 to 8 ohm output. Don't confuse this speaker with many cheap speakers that are offered. This is a fine quality speaker. Stock No. CU-14Y. Sale price $12.95 each, two for $25.00.

Model P15-CR, 15" high fidelity coaxial PM speaker. Response down to 20 cps. and up to 17,500 cps. Full 21½ oz. Alnico V magnet in the 15" woofer. Specially made, coaxially suspended 5" high frequency tweeter. Built-in crossover network. Only two wires to connect. Matches 3.2 to 8 ohms output transformer. A regular $62.50 list speaker. Model P15-CR. McGee's Sale Price, $23.95.

McGee's new 15" Junior coaxial PM speaker. 15" woofer has 6.8 oz. Alnico V magnet. 5" coaxially suspended tweeter with crossover. Only two wires to connect to any 8 ohm radio or amplifier. Frequency response from 40 to 15,000 cps. Model No. M15-CR, 15" Junior coax PM speaker, Sale price, $16.95.

NEW 6-TUBE, 12-VOLT UNIVERSAL MOUNTING AUTO RADIO WITH 5" x 7" OR 6" x 9" SPEAKER — **SALE PRICE $29.99**



6-TUBE, 6-VOLT WITH SPEAKER $19.99

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NEW 12-VOLT MODEL WITH SPEAKER $29.99

Model AH-1259, 12 volt universal mounting auto radio. This is the same set as pictured above (AH-759), except made for 12 volt model 1955 and 1956 cars. Stock No. AH-1259 with 6x9" or 5x7" speaker, $29.99. Stock No. RP-232X, 6x9" rear seat speaker kit for 12 volt cars, $4.99 extra.

NEW 8 TUBE 6 VOLT PUSH-BUTTON MODEL $39.95

New model SH7855S, 8 tube, 6 volt universal mounting auto radio with push-buttons and 2-5x7" PM speakers. These sets were made for Hudson but due to their small compact construction they can be fit into the dash of many cars. Also, ideal for underdash mounting. Has 8 tubes with push-pull 6AQ5 output. Same general appearance and size as model AH-759 pictured above. Ship. wt. 14 lbs. Stock No. SH7855S, Sale price, $39.95. Top cowl antenna $2.29 extra.

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TV Receivers Now Use Selenium Diodes

By **T. P. CLEMENTS** and **HUGH S. WYETH**
Admiral Corporation Service Division

Fig. 1. The two small International Rectifier Corp. selenium diodes on the tube base at the left replace the 3AL5 in a TV sync discriminator circuit. The diagram shows wiring details.

Cheaper and more reliable than vacuum tubes for some applications, more and more of these units are destined to be used in TV sets. Here is operating and test data.

THE progressive development of selenium diodes has resulted in their replacing tubes not only in power supplies, but in other circuits as well. One new application in TV receivers is the use of a pair of subminiature selenium diodes as a horizontal sync phase discriminator instead of the duo-diode tube previously used in this circuit.

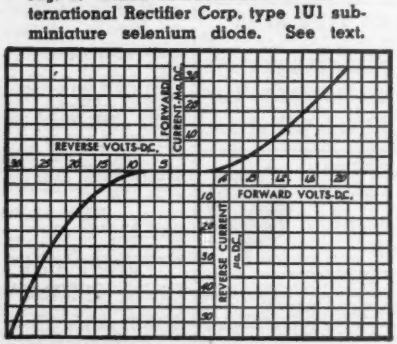
Admiral first used these new subminiature selenium diodes in its 17X3 series chassis for 1956 17-inch models. Originally, this chassis used a 3AL5 duo-diode receiver tube as a horizontal sync phase discriminator, but this tube has been replaced by the plug-in unit with two selenium diodes, shown in Fig. 1. These diodes are manufactured by the *International Rectifier Corporation*. In later *Admiral* chassis the selenium duo-diode is wired onto the automation-produced printed-wiring boards.

At first, the selenium diodes were wired to a tube base so their advantages could be obtained without waiting for the redesign of the printed-wiring board, and to allow a 3AL5 tube to be used as a service replacement in this socket until subminiature seleniums become more easily available to television service technicians. Strangely enough, some service technicians thought that the factory had left some sort of test plug in the socket and promptly replaced the selenium duo-diode with a tube.

What advantage is there in using subminiature selenium diodes instead of tubes? The subminiature seleniums cost much less than a duo-diode vacuum tube, are much smaller in size, do not require any heater power, and are more reliable. They also cost less than germanium diodes. When circuit requirements do not exceed the capabilities of selenium diodes, there is every advantage in using them, and undoubtedly they will be used more and more in television receivers.

Subminiature selenium diodes are potted in a thermosetting compound to protect them from moisture, corrosive atmosphere, and fungus. They will operate in temperatures as cold as the North Pole and as hot as boiling water. Aside from their application as horizontal sync phase discriminators in television receivers, they are used for bias supplies, power supplies for sensitive relays, in computers, and in many other circuits.

Fig. 2. Static characteristics of the International Rectifier Corp. type 1U1 subminiature selenium diode. See text.



RATED FORWARD CURRENT = 1.5 ma.
MAXIMUM APPLIED VOLTAGE = 26 v. r.m.s.
MAXIMUM D.C. OUTPUT VOLTAGE = 20 v.
PEAK INVERSE VOLTAGE = 60 v.

Their electrical characteristics are similar to those of germanium diodes with which the television service technician is already familiar. Like germanium diodes, they have a slight reverse current. The characteristics of a typical subminiature selenium diode are illustrated in Fig. 2.

Selenium diodes will not replace either tubes or germanium diodes in all applications. The reverse current of selenium and germanium diodes often disqualifies them for some applications. The capacity of selenium diodes is another limitation, for their shunt capacitance is greater than that of either a germanium or vacuum tube diode. The somewhat higher shunt capacity of selenium diodes limits their use to circuits which handle signal frequencies below 100 kc. Their operation in circuits like the horizontal sync phase discriminator is very satisfactory. How they function here can be explained by referring to Fig. 3.

In Fig. 3 is shown the horizontal sync phase discriminator circuit used in 1956 *Admiral* TV receivers. The function of this circuit is to generate a correcting voltage for the horizontal oscillator if the latter's frequency is incorrect. If the grid voltage of the horizontal oscillator tube is made less negative, the oscillator frequency will increase; if the grid voltage is made more negative, the frequency will decrease. The horizontal sync discriminator compares a sample of the hori-

zontal oscillator output with the frequency and phase of the incoming horizontal sync pulses and then develops a correction voltage that will speed up or slow down the horizontal oscillator, keeping it in exact synchronization with the received sync pulses.

From the sync inverter tube, V_{401}, which serves as a phase splitter, positive-going horizontal sync pulses are applied to the anode of diode 1 and negative-going sync pulses of equal amplitude are applied to the cathode of diode 2. Both diodes will conduct during the time of each horizontal sync pulse. If both diodes conduct equally, the voltage drops across resistors R_{427} and R_{428} will be equal. Under this condition of normal operation, there will be no d.c. voltage across R_{429} and no correction voltage applied to the horizontal oscillator tube grid.

A saw-tooth waveform is coupled from the horizontal deflection circuit to the cathode of diode 1 and the anode of diode 2. If the horizontal oscillator frequency and phase are correct, this saw-tooth voltage will be passing through zero at the same time the horizontal sync pulses arrive, the diodes will conduct equally, and no correction voltage will be developed. However, if the oscillator frequency should change, the horizontal saw-tooth voltage will not be passing through zero at the time the sync pulses arrive and, as a result, the total voltage across each diode will differ. This will result in unequal conduction of the diodes, the voltage across resistors R_{427} and R_{428} will be unequal, and there will be a d.c. voltage across the common load resistor, R_{429}. This d.c. voltage will be applied to the grid of the horizontal oscillator to bring it back to the correct frequency and phase for perfect synchronization.

What trouble symptoms will be caused by an open or shorted selenium diode in this circuit? Failure of either diode will cause complete loss of horizontal sync or "touchy" horizontal sync. If this symptom exists, there are two ways of determining whether the selenium diode is good or not. One way is to check the resistance of the diode with an ohmmeter. In the circuit of Fig. 3, it is unnecessary to disconnect the diodes when making ohmmeter checks because of the relatively high shunting resistance. With the ohmmeter leads connected one way the resistance will be 2000 ohms or less; with the leads reversed the resistance will be many thousands of ohms. The exact resistance measured will vary considerably depending on the ohmmeter and the scale used, but the resistance reading in one direction should be at least ten times greater than in the reverse direction.

Ohmmeter resistance readings can only be used as a rough check of selenium (or germanium) diodes because the indicated resistance will depend on the voltage applied to the diode by the ohmmeter. This can be understood by examining the static

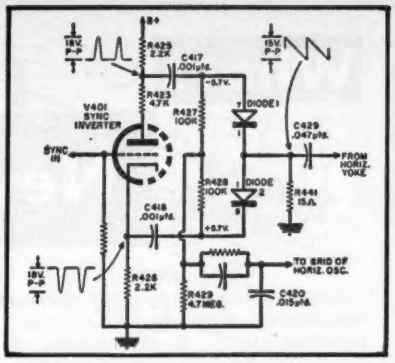


Fig. 3. Horizontal sync phase discriminator circuit used in the Admiral 17X3 series TV chassis. Originally the two subminiature selenium diodes were inserted on a tube base but now they are wired directly onto the printed circuit.

characteristics of the selenium diode in Fig. 2. For instance, if the ohmmeter should apply 1.5 volts to the diode the low, or forward, resistance will be about 750 ohms, while if the ohmmeter applies only .5 volt across the diode, the indicated resistance will be about 2000 ohms.

Another and perhaps better method to determine if the selenium diodes are OK or not is to first check the voltages in the circuit where they are used. For example, in Fig. 3, if one of the diodes is either shorted or open, the picture will be far out of horizontal sync, but the vertical sync will be OK. With no signal being received, the voltage at the anode of diode 1 should be from 5 to 7 volts negative with respect to the chassis, and the voltage at the cathode of diode 2 should be from 5 to 7 volts positive. If these voltages are correct, the selenium diodes are OK, and the trouble must be somewhere else. If these voltages are incorrect, chances are that C_{427}, C_{428}, or C_{429} are leaky, the horizontal oscillator tube is defective, R_{427} and R_{428} are not equal in value, or, finally that one or both diodes are faulty.

If both voltages are positive, it is likely that C_{417} is leaky. C_{417} can be checked for leakage by shorting the junction of R_{425} and R_{426} to the chassis; if the capacitor is leaky the voltage at the anode of diode 1 will change. If shorting R_{426} changes the cathode voltage of diode 2, C_{418} is leaky. If there is a positive voltage at the junction of R_{441} and C_{420}, then C_{420} is leaky. The horizontal oscillator tube can be eliminated as the cause of the incorrect voltages by shorting C_{420}.

In addition to the subminiature selenium diodes of the kind used in *Admiral* television receivers, a wide variety of other types are available. They are furnished for output voltages of from 20 to 160 volts and output currents of from 100 microamperes to 11 milliamperes. The small size of these subminiature diodes, their low cost, and their convenient electrical and physical characteristics will surely result in subminiature seleniums becoming a common sight to television and electronic technicians. —30—

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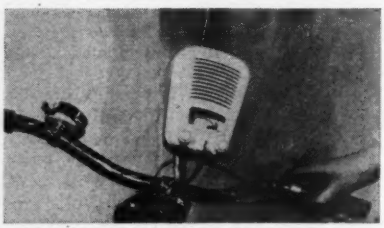
What's New in Radio

BIKE RADIO

Silver Bells, Ltd., 3367 Fernside Boulevard, Alameda, California is handling the U. S. distribution of a novel German-built bicycle radio.

The four-tube set covers the range from 510 to 1625 kc. It is housed in a



colorful unbreakable cabinet with permanent dynamic speaker. A telescoping antenna extends to 30 inches. A special key prevents tampering with the receiver. Battery life is at least 100 hours.

For information and prices on this AWB bicycle receiver write to Peter J. Wangoe in care of the distributor.

SELENIUM RECTIFIER TESTER

Winston Electronics, Inc., 4312 Main Street, Philadelphia 27, Pa. is now offering its Model 610 dynamic selenium rectifier tester, an instrument incorporating dynamic pulsing to test the rectifier under actual load conditions.

A flashing red light acts as a monitor to show the pulsing action. Rectifier quality as well as shorts, leakage, and open circuit conditions are indicated on the multi-color "Good-Bad" scale of the meter. Fixed resistor loads avoid instrument burn-outs and

give increased accuracy. Five fixed resistor loads are calibrated to test rectifiers from 20 ma. to 1000 ma.

CRYSTAL PHOTOCELL

Clairex Corporation, 50 West 26th Street, New York 10, New York, has developed a new photoconductive cell which is extremely sensitive to the red and near infrared region of the spectrum.

Of polycrystalline cadmium selenide, the new unit has a small time constant and a very high ratio of dark-to-light resistance. The sensitivity element of the CL-3 has a rectangular area of approximately $\frac{1}{10}$" x $\frac{3}{16}$". The sensitive area is $\frac{1}{8}$" from one end of an epoxy resin cylinder $\frac{1}{4}$" in diameter and $\frac{1}{2}$" long.

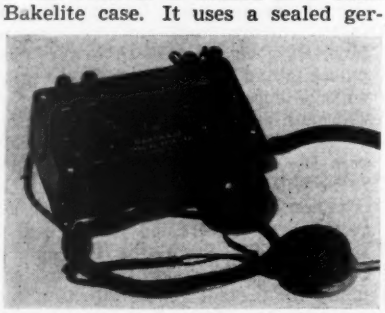
Write the company direct for a copy of the data sheet covering the CL-3.

HEATH CRYSTAL RECEIVER

An interesting project for the beginner is the new crystal receiver kit just released by *The Heath Company*, Benton Harbor, Michigan.

The CR-1 covers the band from 540 to 1600 kc. It has two high "*Q*" tank circuits that employ ferrite-core coils and conventional air tuning capacitors. The capacitors are tuned individually to the desired stations.

The receiver is housed in a black Bakelite case. It uses a sealed ger-



manium diode for detection. The kit includes a pair of high-impedance headphones, instead of the usual single headphone. The company suggests that the set could also be used as an AM tuner in hi-fi applications.

In addition to step-by-step assembly instructions and pictorial diagrams, the construction manual provides the kit builder with the basic fundamentals of signal reception.

TRANSISTORIZED MIXER-AMP.

Baird Associates, 33 University Road, Cambridge 38, Mass., is now offering a new transistorized mixer amplifier, the Model JG2.

Designed especially for remote-pickup recordings, outside p.a. systems, and "on-the-spot" interviews, the Model JG2 is entirely self-contained including a 13-volt power supply which can operate with a wide variety of standard mercury cells. The batteries are housed in specially designed, spring-loaded holders that facilitate rapid replacement in the field.

The circuit consists of two, low-noise preamp stages, one low-noise mixer stage, one amplifier stage, and one output stage. Junction transistors of the

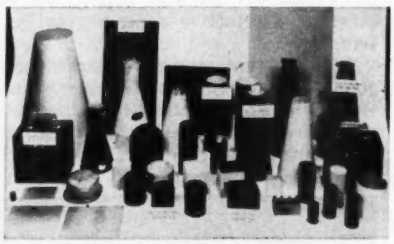
p-n-p type are used in all stages except the amplifier or driver stage. The driver stage uses *n-p-n* transistors.

Complete specifications on this mixer amplifier are available from the manufacturer on request.

MAGNETIC SHIELD TEST KIT

The Magnetic Shield Division of *Perfection Mica Company,* 20 N. Wacker Drive, Chicago 6, Illinois is now offering a multi-purpose magnetic shield testing kit which uses the company's recently developed shielding material.

The shielding material in the kit is designed for a wide variety of applications including (1) flat shielding sheets capable of being formed into many shapes to shield motors, deckplates, turntables, etc.; (2) transformer can shields in various sizes to attenuate hum, prevent coupling from solenoid to solenoid and to prevent scope beam distortion resulting from the transformer (a combination high-low intensity shield is used); and (3) rectangular memory tube storage container shield using a combination of high and low intensity shields. In addition, the kit contains box-shape tape container shields for preserving recording tape and for numerous evaluation tests, CR tube combination shields for high and low attenuation, magnetron storage and shipping container shields, and miscellaneous high or low attenuation shields for other experimental and evaluation purposes.



NEW G-E TRANSISTORS

General Electric Company, Electronics Park, Syracuse, New York has announced the availability of three new inexpensive transistors which have been designed especially for high-fidelity amplifier or broadcast receiver applications.

The new transistors, all *p-n-p* types, include six different types for the output stage of an audio amplifier and four types for the driver stage. The units have been designated as the 2N186A 2N187A, 2N188A, 2N186, 2N187, 2N188, 2N189, 2N190, 2N191, and 2N192.

The Semiconductor Products Division of the company will supply additional details on request.

TINY DIELECTRIC TRIMMERS

Three new miniature air dielectric trimmer capacitors, said to be the smallest ever produced in the U. S., have been introduced by *Radio Condenser Company,* Davis & Copewood Streets, Camden, New Jersey.

Designated as the "subminiature

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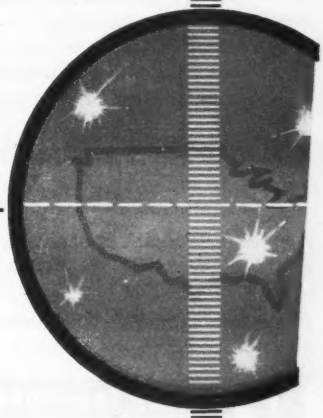

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- Correct tap location for optimum Ultra-Linear performance. Tight coupling between screen and plate winding sections.
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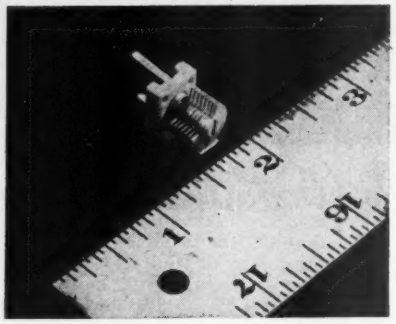
trimmer series 75," the new units are designed for tab mounting on dip-soldered printed wiring boards or screw-mounting on conventional chas-



sis. The new units measure just $25/64$" x $7/16$" x $17/32$" behind the mounting surface.

The capacitors have a minimum effective capacity range of 5, 10 and 15 $\mu\mu$fd. The nominal minimum capacity of the three units is 1.2, 1.2, and 1.5 $\mu\mu$fd. respectively. Complete details on the new series is contained in Engineering Bulletin TR-123, which is available from the manufacturer on request.

TRANSISTOR OSCILLATOR

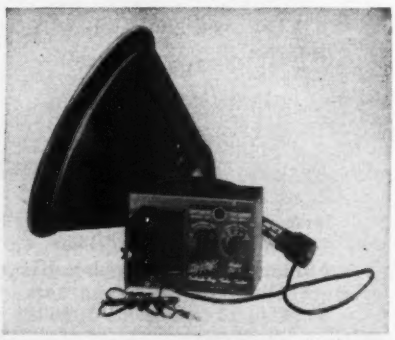
A crystal-controlled transistor oscillator has been developed by the *James Knights Company* of Sandwich, Illinois which offers a complete plug-in signal source with fixed temperature and humidity environment for transistor and circuitry elements.

Each transistor oscillator includes a special crystal, designed for the particular application, with tight angle control and tolerances. Each oscillator is individually tailored for the frequency and other parameter values of the crystal and the transistor with which it will be used.

Write the company direct for full details on specific applications.

TV PICTURE-TUBE TESTER

The Hickok Electrical Instrument Co., 10524 Dupont Avenue, Cleveland 8, Ohio has released a new cathode-ray tube tester specifically designed



for use by TV technicians and dealers, in checking the electron gun of CR tubes.

The new unit tests for both shorts and open elements in the electrodes of the electron gun through use of a sensitive neon lamp. Identified as the Model CR5 "Videochek," the instrument permits a rapid determination of the condition or quality of the emitting cathode. This check uses the cathode-ray tube in conjunction with a neon lamp in a bridge circuit as a peak-reading v.t.v.m. The combination is rugged, both electrically and mechanically, and there is no sensitive meter to be damaged.

The entire instrument is housed in a metal case measuring 6" x 8½" x 3" weighing 5 pounds. The unit operates on 117 volts, 50 or 60 cycles.

"PAGEMASTER"

The Telephone Division of *Stromberg-Carlson,* Rochester, New York is in production on the firm's "Pagemaster," a selective radio paging system.

The new unit serves to locate personnel quickly in locations or situations where conventional paging systems are undesirable or ineffective. The principal feature of "Pagemaster" is a small radio decoder, about the

size of a pack of cigarettes. Each such decoder responds to a certain coded radio signal. When it receives that signal, it emits a pleasant audible tone which is a message to the individual carrying or using that particular decoder that he is being paged. He then goes to the nearest telephone and identifies himself to the operator to receive the message.

The decoder measures 2½" x 3⅝" x 1" and weighs 7 ounces. It is housed in a plastic case and is completely self-contained with no external wires required. Power is supplied by a special compact power pack which will operate the decoder for several weeks. Up to 4000 channels can be handled by this system.

CRYSTAL SETS

Radi-Ore Labs, 38 Oneida Street, Lynn, Mass. is now offering two versions of its "Peppy Pal" crystal receiver kit, the KFTP with an earphone and the KFT without.

The kits contain all of the necessary parts including a pre-wound antenna coil. Instructions for assembling the receiver are given in step-by-step progression.

As an interesting and simple project for the beginner, these kits offer many attractive features at low cost.

CONSTRUCTION PROJECTS

LMB, 1011 Venice Blvd., Los Angeles 15, California is now offering a series of experimental projects, circuits for

which will be packed with the firm's extensive line of box chassis.

These "Kit Diagrams" are complete in detail with complete circuit diagrams, photographs, and parts lists. The projects are designed for experimenters, beginners, and hobbyists as well as for classroom instruction purposes. Only standard parts, easily procurable from any distributor, are specified in the circuitry.

The project has been launched with 10 kit diagrams with 10 new circuits to be added each three months. A list of currently available projects can be obtained from the company's distributors or from the manufacturer direct.

MODERATELY PRICED RECEIVER

Hammarlund Manufacturing Co., Inc., 460 West 34th Street, New York, New York is now offering a moderately priced communications receiver, the HQ-140-XA.

The new model is an improved version of the company's HQ-140-X. It is housed in a functional cabinet and provides up to 2 watts of audio power output. A ruggedized yet smooth-operating tuning dial drive permits extremely accurate logging with greatly improved accuracy in the dial markings.

EXPERIMENTAL DESIGN KITS

Erie Resistor Corporation, Erie, Pa. has announced the availability of a series of experimental design kits whioh will enable engineers and designers to produce working breadboard prototypes and establish design centers using the company's "PAC" modular technique.

The kits are available in three models, 5%, 10%, and 20%. The 5% kit includes 145 RETMA resistor values and 50 RETMA capacitor values. The 10% kit contains 73 and 32 components, respectively, while the 20% kit has 37 and 17 items. Each value is represented by a minimum of 10 components while the more popular values contain 20 components.

(*Continued on page* 104)

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if you have a trade school education or the equivalent in any of the following fields—

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TRANSFORMER: to build a wide variety of experimental transformers, working from samples and specifications.

FABRICATION PLANNER: to lay out and break down electronic equipment for wiring by small pilot assembly group.

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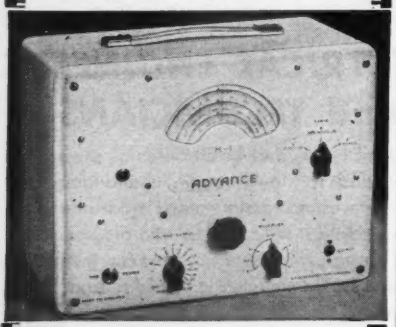

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■ ADVANCE Model H-1 Audio Generator covers, in three ranges, 15 cps to 50 Kc, both sine and square waves. On *sine* waves, accurate to ± 1%, ± 1 cycle; less than 1% distortion at 1 Kc. Output ± 2 db, 200 uv to 20 volts. On *square* waves, less than 3 microseconds rise time; output 400 uv to 40 volts. **Only $82.50**

RF SIGNAL GENERATOR

■ ADVANCE Model P-1 RF Generator covers 100 Kc to 100 Mc on *fundamentals* in six ranges, calibrated to 1%. Output variable from 1 uv to 100 mv, ± 6 db, ± 3 uv. 3 Outputs: 75 ohms, 37 ohms, 10 ohms. Audio modulation 30% at 400 cycles; AF output 0-8 volts. **Only $69.50**

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All kits include a universal wiring board which employs the standard .2" grid system and will provide a means of circuit design which will closely duplicate the finished printed wiring "PAC" layout.

Write the company direct for full details on these new design kits.

TRANSISTORIZED V.O.M.

New London Instrument Company, New London, Conn. has developed a transistorized voltohmmeter which is characterized by light weight and high sensitivity.

The Model 400 features a wide range of voltage and resistance measure-

ments which extend its usefulness into such fields as servo systems, computers, and low level audio. In industrial applications, it will measure the output of transducers, thermocouples, and bridges. It will also handle signals encountered in magnetic modulators, square-law crystals, and photocells.

Complete technical information on the Model 400 is available from the company at 53 Union Street, New London.

SOLDERLESS TERMINAL KIT

Vaco Products Co., 317 East Ontario Street, Chicago 11, Illinois is now offering a new solderless terminal kit designed for hobbyists, amateur radio and TV set builders, hi-fi fans, TV service technicians, etc.

Kit No. 395 consists of a cutting, stripping, and crimping tool 8" long, a package of assorted terminals, a 3/16 x3" round blade plastic handle screwdriver, and a plastic pouch for housing all the equipment.

The kit will be handled through hardware stores and parts distributors at a special "package" price, which is below the cost of the separate items.

REMOTE CONTROL

Tello Corp., 342 Madison Ave., New York, N.Y. has recently introduced a remote switching device which consists of an 8 ft. cord with a unique phone-mounted switch assembly.

When the phone is used, the output of the TV set or hi-fi unit is shorted out. Volume is automatically restored when the telephone is replaced in its cradle. -30-

MARYLAND PHONE NET

THE Maryland Emergency Phone Net will hold its annual picnic in Braddock Heights Park, Braddock Heights, Md. on Sunday, July 22 from 10 a.m. on.

There will be contests, ladies' and children's programs, a rummage sale, and lots of prizes.

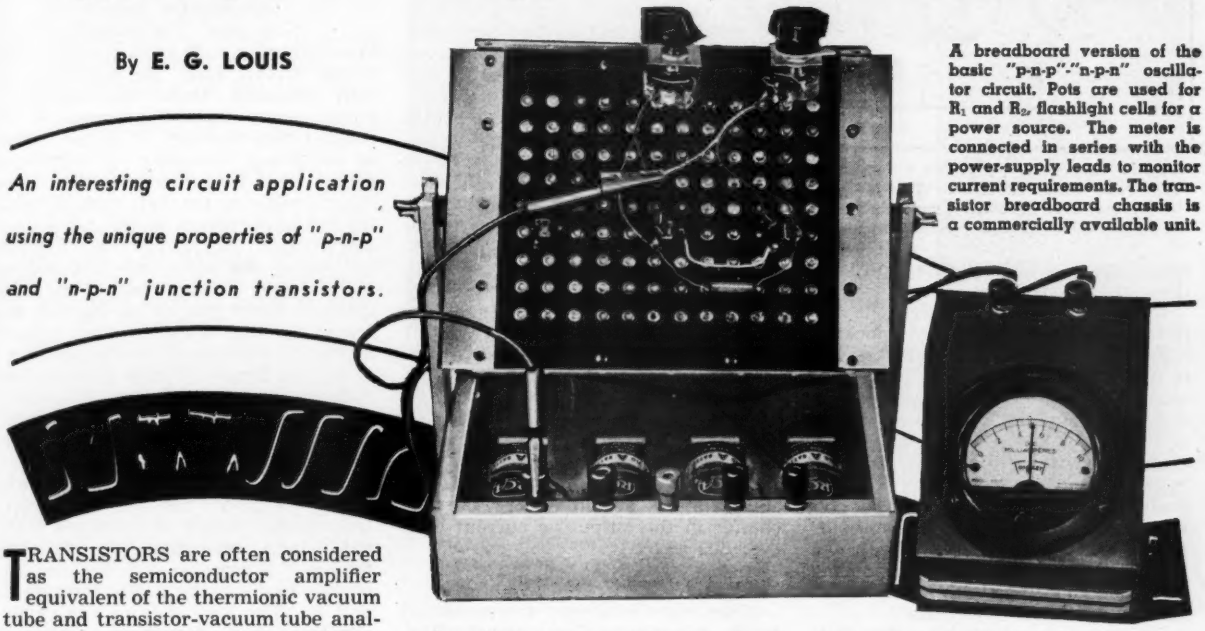
Make reservations with C. C. Worsley, W3TYJ, 104 Northwood, Silver Spring, Md. Tickets for adults are priced at 50 cents each with children under 12 admitted free. -30-

The fact that the Army's field radios "can take it" was amply demonstrated recently and reported to the public by Jack Eggert, a communications expert of the Army's Signal Corps Engineering Laboratories, Fort Monmouth, New Jersey. The equipment worked through a test atomic blast that burned the mannequins "operating" them to a mound of ashes. The gear stayed on the air although some were as close as 1000 feet to ground zero. Sets were found outwardly charred and battered at the bottom of fox holes, but internal parts remained sound. Modern small radio parts and shock-proofing techniques were credited with giving these sets their endurance. In the photo (left) a mannequin with a "walkie-talkie" radio slung over his back lies face down at the bottom of a fox hole just before an atomic blast at the Nevada Proving Ground. (Right) A scattered pile of ashes is all that remained of the dummy after the blast but the radio remained in perfect working order.

"p-n-p"-"n-p-n" Oscillators

By E. G. LOUIS

An interesting circuit application using the unique properties of "p-n-p" and "n-p-n" junction transistors.



A breadboard version of the basic "p-n-p"-"n-p-n" oscillator circuit. Pots are used for R_1 and R_2, flashlight cells for a power source. The meter is connected in series with the power-supply leads to monitor current requirements. The transistor breadboard chassis is a commercially available unit.

TRANSISTORS are often considered as the semiconductor amplifier equivalent of the thermionic vacuum tube and transistor-vacuum tube analogies are frequently used to discuss and explain the operation of basic transistor circuits. The analogous operation of these two amplifying devices is also used in serious circuit design work by applying the concept of "duality" to the problem of translating known vacuum tube circuits to their transistor equivalents. A circuit is considered the "dual" of another when current in one behaves like voltage in the other. In circuit design, the technique is primarily a mathematical operation and consists of considering the transistor as the dual of the vacuum tube, then translating all vacuum tube circuit parameters into their "dual" in the proposed transistor circuit. Circuit elements which have *current* characteristics are substituted for those with *voltage* characteristics; thus, a series-tuned circuit may be substituted for a parallel-resonant circuit, a capacitance for an inductance, conductance for resistance, and a current source for a voltage supply.

In a vacuum tube, electron flow is always from cathode to plate; in general, a negative-going signal applied to the grid electrode results in a decrease in plate current, with a positive-going signal giving an increase in plate current in the popular grounded-cathode circuit. With junction transistors, on the other hand, two similar, but opposite, conditions may exist, depending on the type of transistor used. With a *p-n-p* transistor, in the grounded-emitter circuit, a negative-going signal results in an *increase* in collector current, but with an *n-p-n* transistor, in a similar circuit, a negative-going signal results in a *decrease* in connector current. Similar opposite effects occur with positive-going signals, which cause a decrease of collector current in a *p-n-p* transistor, but an increase in collector current with *n-p-n* units. As far as direct currents are concerned, and assuming normal supply voltage and bias operation, the current flowing through each electrode of a *p-n-p* unit is exactly opposite that of the current through the corresponding electrode of an *n-p-n* transistor.

The practical application of the opposite but symmetrical characteristics of *p-n-p* and *n-p-n* junction transistors, known as the "complementary symmetry" principle, has permitted the development of a whole class of transistor circuits for which there are no vacuum-tube equivalent or *dual* circuits. Two "classic" examples of the application of the complementary symmetry principle to practical circuits are given in Fig. 1. A single-ended push-pull amplifier is shown in Fig. 1A, and a simple direct-coupled amplifier in Fig. 1B.

Referring to Fig. 1A, C_1 and C_2 serve simply as d.c. blocking capacitors. Voltage divider R_1-R_2 supplies base bias current to the *p-n-p* transistor, while divider R_3-R_4 serves a similar function for the *n-p-n* unit. The power sources (batteries) supply d.c. operating voltages of opposite polarity to the electrodes of the two transistors. Either two separate batteries or a single tapped unit may be employed. The output load impedance, R_L, is common to the collector circuits of both transistors. For best results in a circuit of this type, the two transistors used should be "matched" so that they have similar gain and static (d.c.) characteristics.

In operation, with no signal applied to the input, the d.c. collector currents of the two transistors are equal but of opposite polarity. Hence they cancel

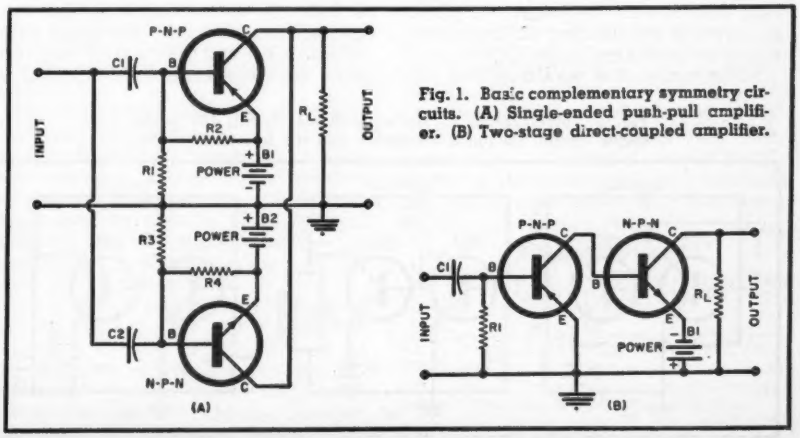


Fig. 1. Basic complementary symmetry circuits. (A) Single-ended push-pull amplifier. (B) Two-stage direct-coupled amplifier.

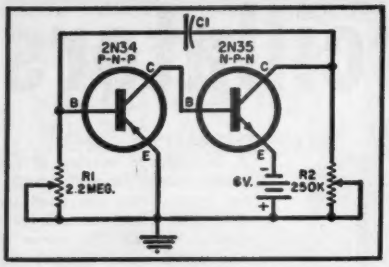


Fig. 2. The basic "p-n-p"-"n-p-n" oscillator circuit described in text. This is one of the simplest transistor multivibrators possible using junction-type transistors.

and there is no d.c. flowing through the load impedance R_L.

When a positive-going signal is applied to the input, through blocking capacitors C_1 and C_2, the collector current of the *p-n-p* transistor decreases, while the collector current of the *n-p-n* unit increases. The two currents no longer cancel and the unbalance current flows through the load R_L. With a negative-going signal, the opposite action takes place. The collector current of the *p-n-p* transistor increases, while that of the *n-p-n* transistor decreases, again producing an unbalance current which flows through the load impedance.

Thus, the opposite but similar characteristics of the *p-n-p* and *n-p-n* transistors have been utilized in a circuit which has many of the characteristics of a true push-pull amplifier, but with a single-ended input and output. As a further feature, no d.c. flows through the load impedance (R_L) under "zero" signal conditions, and without the use of capacitive coupling or an output transformer!

Referring to Fig. 1B, the characteristics of *p-n-p* and *n-p-n* transistors have been utilized to design a simple two-stage, direct-coupled amplifier with a single power source. As before, the input capacitor, C_1, serves simply for d.c. blocking purposes. R_1 is the "base return" resistor. As shown, the first stage will act as a clipper since no base bias current flows through the *p-n-p* transistor. For class A amplifier operation, the lower end of R_1 is returned to the negative terminal of the power source. R_L is the output load impedance. Although a resistor is shown, a transformer or impedance might be used here.

In operation, if a negative-going signal is applied to the input, through C_1, the collector current of the *p-n-p* transistor increases. The amplitude of the collector current change will be several times that of the input current change due to the transistor gain. But the collector current of the input *p-n-p* transistor is also the base current of the *n-p-n* transistor. Thus, an increase in the collector current of the *p-n-p* transistor results in an increase in the collector current of the output *n-p-n* transistor but, again, of much greater magnitude due to the gain of the second stage. An increase in the collector current through R_L develops a negative-going signal across this load impedance. Since this is a direct result of the application of a negative-going signal to the input, the input and output signals are in-phase. The over-all gain obtained is the product of the gains obtained in each stage. As an example of the gains possible, in an experimental circuit developed by the author, using direct-coupling throughout (no input blocking capacitor), a 2 microampere change in the input resulted in a 1 milliampere current change in the output—a current gain over 500 at d.c.!

Basic Oscillator

Since the two-stage, direct-coupled *p-n-p—n-p-n* amplifier shown in Fig. 1B is capable of supplying considerable gain and, further, since the input and output signals are in-phase, it would appear a simple matter to convert this into an oscillator by coupling the input and output together. Such is the case, and the resulting multivibrator circuit, shown in Fig. 2, is perhaps the simplest multivibrator possible with junction transistors, with only three components required, other than the transistors themselves and the power source. In some cases, one of these components (R_1) may be eliminated. Almost any type of impedance may be used for coupling the input and output, as long as d.c. levels are taken into account. For most practical work, capacitor coupling, as shown in Fig. 2, is preferred, however.

The parts values given in Fig. 2 are for a typical experimental circuit setup employing *Sylvania* transistors, and the average experimenter should have no difficulty assembling a similar circuit for his own tests. The input base resistor (R_1) and the output load resistor (R_2) are variables to permit a study of the circuit under different conditions.

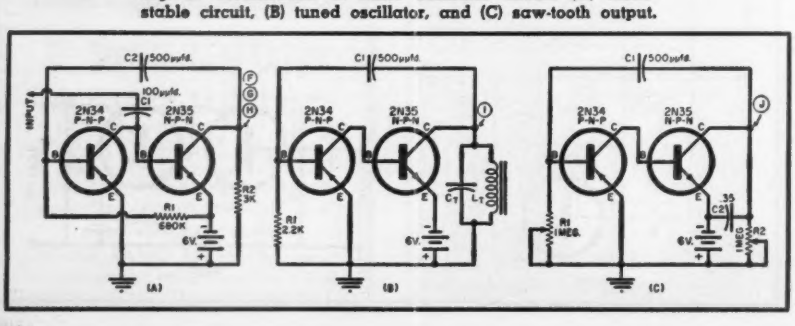
In operation, capacitor C_1 charges rapidly through the emitter-collector circuit of the *n-p-n* (2N35) transistor and the base-emitter circuit of the *p-n-p* (2N34) unit. The polarity of the loop current is such as to continue the action rapidly until the capacitor is fully charged, thus, the negative-going signal appearing across R_2 is coupled back through C_1 to the input of the *p-n-p* transistor. A negative-going signal here increases the transistor's collector current, thus increasing the base current of the *n-p-n* unit and further increasing the collector current of the *n-p-n* unit, continuing the charging action. Once C_1 is fully charged, there can be no further increase in the negative-going signal applied to the base of the *p-n-p* transistor and hence the base current and collector current of this transistor drop to close to zero. A drop in the collector current of the *p-n-p* unit drops the base current (and hence the collector current) of the *n-p-n* transistor, virtually "opening" the emitter-collector circuit of the *n-p-n* transistor and removing the charging source (battery), permitting the capacitor to discharge slowly through R_2 and R_1. The discharge of the capacitor through R_1 is such as to apply a positive-going signal to the base of the *p-n-p* transistor, keeping both the *p-n-p* and *n-p-n* transistors "open." Collector current is close to zero.

Both transistors remain in a non-conducting state until capacitor C_1 is discharged. Then the charging action resumes. The frequency of operation depends on the time constants of the *RC* circuits, and varying either C_1, R_1, or R_2 will shift frequency. In general, as any of these components are made smaller, the frequency of operation will increase. The output signal is a negative-going pulse, developed across R_2, with the waveshape dependent, to some extent, on the value of the components used. Typical oscilloscope patterns, as observed with a *Heathkit* Model O-9 oscilloscope, are shown in Figs. 4A, 4B, 4C, 4D, and 4E.

The patterns shown in Figs. 4A, 4B, and 4C were all obtained with C_1, equal to 0.0005 μfd., with a total current drain ranging from 0.2 ma. to 0.6 ma. at 6 volts. Operating frequencies are 4 kc., 1.7 kc., and 1.2 kc., respectively. In general, as R_2 is made smaller, the negative-going pulse narrows. No record was kept of actual resistance values, however. The waveform pattern shown in Fig. 4D is at a frequency of 3.3 kc., C_1 equal to 0.0005 μfd., R_1 is 100,000 ohms, and R_2 is 3000 ohms; total current drain is 1.0 ma. at 6 volts. The pattern shown in Fig. 4E is at a frequency of 1.1 kc., C_1 equal to 0.002 μfd., R_1 is 100,000 ohms, and R_2 is 3000 ohms; total current drain is 0.6 ma. at 6 volts.

Depending on the "back resistance" of the base-emitter circuit of the *p-n-p* transistor, it is sometimes possible to eliminate R_1 altogether and still ob-

Fig. 3. Modification of basic oscillator circuit. (A) monostable circuit, (B) tuned oscillator, and (C) saw-tooth output.



tain reliable oscillation. This results in a multivibrator with only two components, other than the transistors, load resistor R_2 and coupling capacitor C_1. When this arrangement is used, R_1 is simply removed from the circuit, allowing the base to "float" with no d.c. return to ground other than the internal resistance of the transistor itself.

Circuit Modifications

An almost infinite number of variations of the basic circuit is possible, depending on the needs and requirements of the individual experimenter. Three such modifications are illustrated in Fig. 3, with the corresponding waveform patterns given in Figs. 4F, 4G, 4H, 4I, and 4J.

The circuit given in Fig. 3A is the basic circuit modified to obtain *monostable* operation. The only real change in the basic circuit is the return of the lower end of R_1 to the negative side of the power source. This small change biases both transistors in a conducting state, so that the collector current through R_2 is held to a maximum except when a driving signal is applied through capacitor C_1. C_1 is used only for the application of a control pulse or signal, but is not essential to the operation of the circuit otherwise. With the application of a driving signal of sufficient amplitude, the circuit goes through one cycle of operation, depending on the time constant of the *RC* circuits, as before. A positive-going rectangular pulse appears across R_2, with a peak amplitude equal to the supply voltage, that is, 6 volts peak with the values given in Fig. 3A. The output pulses obtained with a driving signal of 500 cps and 1 kc. are shown in Figs. 4F and 4G, respectively. The appearance of the output pulse when the circuit is driven with a signal at too high a frequency for the circuit time constants is shown in Fig. 4H; an 80 kc. signal was used to obtain this pattern. Total current drain, for the circuit shown, is 2 ma., with a six volt source, and under "no signal" conditions.

Other modifications of the basic circuit are shown in Figs. 3B and 3C, with the corresponding waveform patterns shown in Figs. 4I and 4J, respectively. The circuit shown in Fig. 3B is the basic circuit with the output load resistor (R_2) replaced by a tuned circuit, C_T-L_T. With C_T equal to 0.002 μfd. and L_T equal to 1 hy., the operating frequency was 7 kc.; total current drain was 1 ma. at 6 volts. The circuit given in Fig. 3C is the basic circuit with a capacitor (C_2) connected between the collector and emitter electrodes of the *n-p-n* transistor to shape the rectangular pulse normally appearing here into a linear saw-tooth pattern, as shown in Fig. 4J. Frequency is 650 cps, current drain 0.8 ma. at 6 volts.

A general modification of any of the circuits shown is to interchange the positions of the *p-n-p* and the *n-p-n* transistors. This may be done if the polarity of the power supply is also reversed. Circuit operation is essentially the same as before, except that all signal polarities are reversed. Thus, the basic circuit, given in Fig. 2, supplies positive-going instead of negative-going signals, and the monostable circuit, given in Fig. 3A, supplies negative-going output pulses.

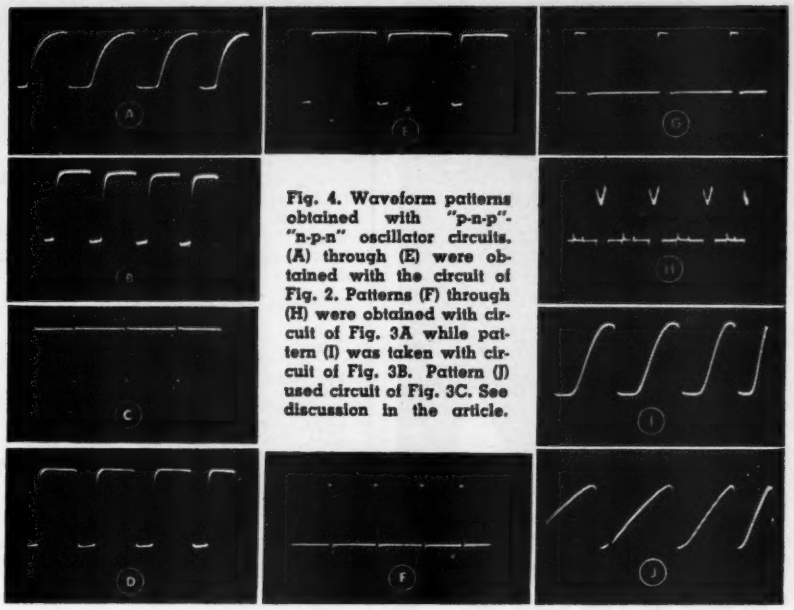


Fig. 4. Waveform patterns obtained with "p-n-p"-"n-p-n" oscillator circuits. (A) through (E) were obtained with the circuit of Fig. 2. Patterns (F) through (H) were obtained with circuit of Fig. 3A while pattern (I) was taken with circuit of Fig. 3B. Pattern (J) used circuit of Fig. 3C. See discussion in the article.

Experimental Lab Hints

All of the circuits shown are well-suited to "breadboarding" and experimental tests by hams, students, design engineers, and home experimenters alike. No difficulty should be experienced in obtaining oscillation as the circuits are completely non-critical, both as to component values and circuit layout. With the recent major reductions in the cost of transistors, components expense is almost negligible.

However, to obtain the maximum value from any experimental tests and to avoid possible components damage, the reader is cautioned to adopt a few general *"rules of practice"*:

(1) Be sure transistors are connected in the proper manner for the battery polarities employed. Remember that different type transistors require exactly opposite d.c. operating voltages.

(2) Where possible, use adjustable components in each part of the circuit to permit minor changes in components values. Either potentiometers or resistance decade or substitution boxes may be used in place of fixed resistors, and a capacitor decade or substitution box may be used in the place of fixed capacitors.

(3) If the transistors specified in the circuits are used, *do not exceed* the maximum ratings of 25 volts and 10 ma. collector voltage and current, respectively. Voltages as low as 1.5 volts will give satisfactory results. To avoid exceeding the maximum current ratings, it is a good idea to connect an 0-10 d.c. milliammeter in series with the battery supply leads.

(4) Use an oscilloscope to observe waveform patterns.

(5) If possible, use transistor sockets instead of soldering the transistors in place.

The reader need not restrict himself to the transistor types specified in the circuit diagrams, provided he takes care not to exceed the maximum ratings of the transistors he uses. The transistors employed need not have similar gain characteristics, as long as both *p-n-p* and *n-p-n* units are used, transistors of different manufacturers may be employed, if desired. However, a small voltage gain transistor should not be employed with a high power transistor where direct-coupling is used.

Acknowledgements

The basic single-ended, push-pull amplifier circuit shown in Fig. 1A was adapted from *Sylvania's* booklet, *"28 Uses for Junction Transistors."* Some of the other circuits shown were adapted from L. E. Garner's forthcoming *"Transistor Circuit Handbook"* (to be published by *Coyne,* distributed by the *Howard W. Sams* organization). The transistors used for "proving out" the circuits shown were supplied by *Sylvania Electric Products Inc.* The commercial "transistor breadboard" shown in the photograph is a product of *The Electratomic Co.,* Wheaton. Md.

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2. Lohman, R. D.: "Complementary Symmetry Transistor Circuits," Electronics, September, 1953.

3. ————: "28 Uses for Junction Transistors," Sylvania Electric Products Inc.

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2B7 Test 2	2.5	76	10046	7	16	Good
2W3	2.5	32	30046	8	2	Good
2X2 (879)	2.5	37	600X6	1	4	Good
2X2A	2.5	37	600X6	1	4	Good
6AJ4	6.3	11	51052	8	*127*	6500
	Put special-normal switch in special position *3, 4, 6, 9,* also show short					
6BH8	6.3	33	52033	4	125	2145
6BH8 Test 2	6.3	17	57892	4	567	4200
6BL4	6.3	13	60056	7	38	Good
	(Pins *1* & *5* also show short)					
6BQ6GA	6.3	75	50046	2	3578	Good
6BQ6GT	6.3	26	354Y3	7	258	3380
6BW4	6.3	60	10076	4	59	Good
6BW4 Test 2	6.3	60	10016	4	59	Good
CK 5694	6.3	44	64034	2	147	1040
CK 5694 Test 2	6.3	44	65064	2	578	1040
CK 5785	1.4	90	10016	6	7	Good
6085 (E80CC)	6.3	37	67063	9	4578	1855
6085 (E80CC) T2	6.3	37	62013	9	2345	1855
6086 (18042)	19.6	18	52162	4	2359	5330
9005	2.5	65	10046	1	367	Good

JACKSON MODEL 49

Tube	Section	A	B	C	D	Cath. Shorts	E
3B2	D	3.0	2	13568	0	..	60
3CE5	P	3.0	3	7X	156	2	30
3DT6	P	3.0	3	X	1567	2	30
4BS8	T	4.2	4	X	12	3	30
	T	4.2	4	X	67	8	30
5AS4	D	5.0	2	..	4	..	12
	D	5.0	2	..	6	..	10
5BR8	P	5.0	4	X	679	8	30
	T	5.0	4	X	12	3	30
5BT8	P	5.0	4	X	678	9	30
	D	5.0	4	..	1X•	3	47
	D	5.0	4	..	2X•	3	47
5V3	D	5.0	2	..	4	..	10
	D	5.0	2	..	6	..	8
6BE8	P	6.3	4	X	679	8	32
	T	6.3	4	X	12	3	32
6BH8	P	6.3	4	X	789	6	31
	T	6.3	4	X	23	6	31
6BJ8	T	6.3	4	..	78	9	7
	D	6.3	4	..	1X•	2	47
	D	6.3	4	..	6X•	3	47
6BL4	D	6.3	7	1246	5	3	4
6BR8	P	6.3	4	X	679	8	30
	T	6.3	4	X	12	3	30
6BS8	T	6.3	4	X	12	3	30
	T	6.3	4	X	67	8	30
6BT8	P	6.3	4	X	678	9	30
	D	6.3	4	..	1X•	3	47
	D	6.3	4	..	2X•	3	47
6BW4	D	6.3	4	..	1	9	16
	D	6.3	4	..	7	9	16
6CE5	P	6.3	3	7X	156	2	30
6CH7	T	6.3	4	9X	12	3	30
	T	6.3	4	9X	67	8	30
6CL5	P	6.3	2	134	580	6	4
6CU5	P	6.3	3	5	267	1	4
6DN6	P	6.3	2	..	580	3	4
6DQ6	P	6.3	2	..	450	8	4
6DT6	P	6.3	3	X	1567	2	30
12BW4	D	12.6	4	..	1	9	16
	D	12.6	4	..	7	9	16
12CU5	P	12.6	3	5	267	1	4
12DQ6	P	12.6	2	..	450	8	4
19AQ5	P	19.0	3	7	156	2	8
25DQ6	P	25.0	2	..	450	8	4
X-155	T	6.3	4	X	12	3	30
	T	6.3	4	X	67	8	30

Certified Record Revue

(*Continued from page* 58)

will find interesting and attractive. Not the least of these attractions is the common denominator of all Tchaikovsky scores . . . the essential lyricism and the melodic resources. The melodic line here is subdued, but nonetheless contributes much to the beauty of the score. The 4th and last movement of the "Suite" is as famous as the first three movements are obscure . . . the well-known much played "Theme and Variations." This reading by Boult is well thought out and moves along with judicious tempi. The sound also adds to the attractions of the disc, with the strings especially noteworthy for their smooth projection. Both sound and performance-wise this recording is infinitely superior to the Goehr version on a *Concert Hall Society* disc, the only other recording in the catalogue. Recommended.

BACH FOR PERCUSSION

New York Percussion Ensemble conducted by Harold Glick. Audio Fidelity AFLP1812. RIAA curve. Price $4.98.

If you think the title of this disc is confusing, wait until you hear it! A gent named John Klein, a very versatile fellow who has composed quite a number of classical works and who has arranged music on shows like the "Hit Parade" and "Stop the Music," has transcribed three of Bach's great organ works for percussion! The "Toccata and Fugue in D Minor," the great "G Minor Fugue" and the "Toccata in F Major" get the treatment and the results are quite unlike anything you've ever heard. There will be many who will dismiss this as utter nonsense. Others, like the hi-fanatic will greatly enjoy it from the aspects of sound alone, and undoubtedly many serious musicians and musicologists will appreciate the ingenuity of the structure and scoring and the remarkable percussive textures Mr. Klein achieves. If you listen closely, the rhythmic patterns of the Bach works are easily discernible. Probably the biggest sales will be to the hi-fi nut who wants to really gorge himself on percussion and transients. Among the instruments that are heard with superb fidelity are tympani, bass drum, snare drum, claves, woodblocks, tambourine, small and African tom-toms, bongo drums, tam tam, boombams, triangles, cymbals, finger cymbals, conga drums, timbales, cowbells, etc., etc. Whew!

BERLIOZ

FAMOUS OVERTURES

L'Orchestre de la Societe des Concerts du Conservatoire de Paris conducted by Albert Wolff. London LL1297. RIAA curve. Price $3.98.

There will be people who pity conductor Albert Wolff because the poor man never seems to be able to record anything but warhorses. On the other hand, you can hardly blame *London* for this state of affairs, because everything Wolff has done for them, he has done so well that the records are best sellers. Wolff seems to have a peculiar knack of taking even the lowliest potboiler and giving it a new enough twist to make it newly interesting. Of course, the fact that he has also received some of *London's* very best recorded sound doesn't hurt matters! Here we find him holding forth with Berlioz overtures; "Le Corsaire," "Les Francs-Juges," "Le Roi Lear" and "Roman Carnival." While no match for Berlioz champions like Beecham and others, his readings are more than acceptable. No feet dragging here . . . all are nicely paced with brisk, spirited tempi. The orchestra no doubt deriving inspiration from its native repertoire plays very well and, as usual, Wolff has been favored with a hugely proportioned "big-hall" sound, whose rich resonance is complemented by sparkling detail. A delightful recording.

BEETHOVEN

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Claudio Arrau, pianist, with Philharmonia Orchestra conducted by Alcea Galliera. Angel 35300. RIAA curve. Price $4.98.

Angel keeps on adding illustrious names to its roster of artists. Here is newly-signed Arrau's first effort, a splendid reading of Beethoven's "4th Piano Concerto." Also be it noted that *Angel* has contracted the famous Jose Iturbi, and some of his particular keyboard magic will no doubt reach us soon. Arrau's tenure with *Columbia* was not very happy, although several notable recordings were made. To me, he has always seemed a sort of "orphan pianist," not well understood and talent largely misused by the companies recording him. It would seem that Claudio has found a happier niche with *Angel*, at least on the basis of this first effort. This is a beautiful recording, equalled by few and superior to most of the 14 other recordings in the catalogue. His is a warm, highly expressive reading, not without its tougher fiber, but lacking the huge power of the Backhaus or Schnabel versions. His mood is reflective rather than dominant, but this detracts little from his smooth, unmannered exposition of the score. Of the sound afforded Arrau, there is no doubt that this is the most pervasively realistic among all the other recordings. The

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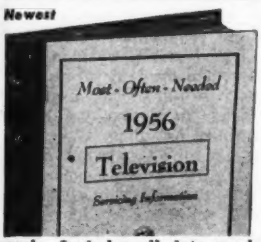

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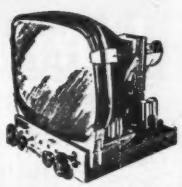

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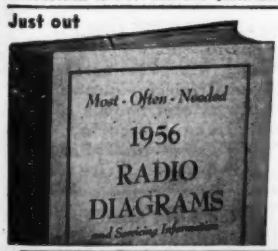

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piano is big-toned, but very smooth and liquid in its projection, there is no transient overload or ringing, no hammer-action sound to spoil the illusion of presence. Galliera contributes a well-balanced, nicely-paced orchestral accompaniment in fine rapport with the soloist. An auspicious debut by Arrau on the *Angel* label.

DEBUSSY
LA MER
NOCTURNES
Boston Symphony Orchestra conducted by Pierre Monteux. Victor LM1939. RIAA curve. Price $3.98.

"Papa" Monteux has been guest conducting with his old orchestra, the Boston Symphony, and now and then *Victor* issues the fruits of some of these sessions. This "La Mer" has much to recommend, being a better performance than most in the catalogue, but like any recording of this work it must inevitably stand comparison with Toscanini's glorious reading. No, it doesn't equal that impassioned *tour-de-force* by the Maestro, but it has virtues of its own, virtues which are really a reflection of Monteux's feeling for the score. He brings to the work order without fussiness, tempi which are brisk but not headlong, and warmth but not passion. The result is easy listening, a confidence in Monteux's orchestral mastery, even though his white-capped sea is subsidiary to the tempest of Toscanini's. Soundwise this is one of the best in the catalogue with fabulous string sound from the Boston players, as well as bright brass and sharp percussion. "Nocturnes" receives a well-rounded performance, excelled only by Stokowski's version. Here too is first class sound with particularly good quality from the chorus in the "Sirenes" section.

GRIEG
PEER GYNT SUITES NOS. 1 AND 2
IPPOLITOFF-IVANOFF
CAUCASIAN SKETCHES
Hollywood Bowl Symphony Orchestra conducted by Felix Slatkin. Capitol P8329. RIAA curve. Price $3.98.

Slatkin is a more than ordinarily perceptive conductor who has done some notably good work for *Capitol*. Even here, saddled with these warhorses, he does an excellent job. He is more successful in his reading of the "Peer Gynt Suites" than Ormandy who is his only close competitor, although his orchestra is no match for the Philadelphians. The popular "Caucasian Sketches" are given a good performance and the sound quality of both this and the "Peer Gynt" is some of *Capitol's* best. Recommended.

BEETHOVEN
SYMPHONY NO. 5
SCHUBERT
UNFINISHED SYMPHONY NO. 8
Boston Symphony Orchestra conducted by Charles Munch. Victor LM1923. RIAA curve. Price $3.98.

Ordinarily, with 15 or 20 recordings of a given work in the catalogue, any further duplication is a case for howls of dismay. And while in most respects a new Beethoven "5th" is hardly cause for rejoicing, there is the saving grace with this work (if with no other) that this new recording might be *it* . . . at last *the* Beethoven "5th." Alas, this effort by Charles Munch achieves the same thing as a number of others . . . a very close miss . . . but no hit. The definitive Beethoven "5th" is not yet, and for that matter may never be. Taken for itself, however, this is one of the best available. Munch has chosen brisk tempi, generally well suited to his demands from the orchestra, and if he had not dragged the *andante* in the second movement, we might have had something. He elicits some wonderfully expressive sound from his great orchestra and the tumultuous finale is perhaps better done than in any recording so far available. The real value of this recording aside from the generally excellent performance is the sound. Once in a while, at a recording session with no change of technique involved, everything just "clicks." Whether it's the hall with that particular repertoire, the temperature in the hall, the spirit of the musicians, whatever it is . . . it happened in this recording. This is Boston Symphony sound which in its warmth, its inner detail, its cleanness of string and brass and woodwind, and its spacious acoustics I have not heard before. It is quite a wonderful effect and makes this record a desirable buy if for no other reason. The Schubert "Unfinished" gets a good but not spectacular performance, but it too in lesser measure shares the bounty of good sound. Try this and see if you concur.

BARTOK
SECOND SUITE FOR ORCHESTRA
Minneapolis Symphony Orchestra conducted by Antal Dorati. Mercury MG 50098. RIAA curve. Price $3.98.

With so much duplication of repertoire going on, it is always a welcome task to review a record premiere, especially when it is a work by an acknowledged master like Bela Bartok. This first LP of his "Second Suite for Orchestra" is going to be hard to beat if there are subsequent editions. For one thing, Dorati who was a friend and pupil of Bartok brings his authority to the reading. For another thing, this has sound that defers to none in matters of wideness of frequency and dynamics and lack of distortion. This colorful score is a product of the young Bartok, completed in 1907 when he was 26. As such, while it does not have as much of the wild atonalities and dissonances of his later works, these elements make brief appearances throughout the score. The work is essentially rhythmical and lyrical and is consequently easier to assimilate than the later scores. As with most Bartok it is full of contrast and, needless to say, lends itself very well as a vehicle for modern hi-fi recording. While not as spectacular in the direct sense as other *Mercury* recordings, it is equally amazing in a different way . . . there are thin gossamer sound textures here which are as difficult to record as the most florid percussion and brass passages. The fine delineation of harp and tympani over bassoon and other woodwinds in the finale and string and woodwind textures in other places is a recording challenge that has been met most successfully. I have no knowledge of the score but Dorati never seems to be in any difficulties and he receives splendid support from his orchestra. This might be a good score for an introduction to Bartok's music, and if there are still some readers who have not made the acquaintance of Bartok, this is less likely to bite you than most of his other works.

FLOTOW
MARTHA (COMPLETE OPERA)
Feruccio Tagliavini, tenor; Carlo Taglibue, baritone; Pia Tassinari, contralto; and Elena Rizzieri, soprano with symphony orchestra and chorus of Radio Televisione Italiana (Turin) conducted by Francesco Molinari-Pradelli. Cetra B1254. RIAA curve. Price $9.96. Two discs.

The second recording of "Martha" in the LP catalogue, this will be welcomed by many for a variety of reasons. It has a far better cast than the *Urania* recording, the sound is infinitely better, it is now two records instead of three and thus cheaper. Infrequently performed in this country, "Martha" still enjoys quite a vogue in Europe. More often than

not "Martha" has come to mean in this country, the famous tenor aria "M'appari," and in the late thirties this was even made into a popular song. For those interested in opera, there is much more to this sparkling score than that one aria, and a listen to this excellent performance will be worth your while. Tagliavini is well cast as Lionel, for the demands of the role are not taxing to his voice except for *the aria*, which he assays with but little straining. Pia Tassinari is her usual reliable self as Nancy, Tagliabue is in good voice as Plunkett. The other singers are completely unknown to me, but do well enough. Rizziere as Lady Harriet ("Martha") has a pretty young voice, with some unsteadiness in her higher register her main shortcoming. Pradelli deserves a lot of credit for holding the production together so well and for his excellent work with chorus and orchestra. Nice sound here, with voices well projected and good balance between vocal and orchestral elements. A desirable recording of an unjustly neglected work.

VERDI
AIDA (COMPLETE OPERA)
Maria Callas, soprano; Fedora Barbieri, mezzo-soprano; Richard Tucker, tenor; Tito Gobbi, baritone; Giuseppe Modesti, bass and soloists with the orchestra and chorus of La Scala (Milan) conducted by Tullio Serafin. Angel 3525C. RIAA curve. Price $15.94. Three discs.

This is a fabulous new production of "Aida" from *Angel*. You might say that this is the final entry in the sweepstakes for recording of choice, the *London* and *Victor* entries having appeared earlier. For those opera lovers who have put off making their purchases until all entries were in, I feel sorry. Not that they have waited unnecessarily, but that the final choice is still more complicated now. In the last analysis, I think you will probably have to ignore the critics and make your own decision based on your preferences for some artists *versus* your prejudices against others.

To illustrate what I mean take the role of "Aida." In this new *Angel* we have the fabulous Maria Callas. Her voice is not generally acknowledged as being too pretty, but none of the other "Aidas" can hold a candle to her acting. Her dramatic intensity, which she manages to project in her voice, is something that few opera singers have and she is unlikely to be surpassed in this respect. In the *London* set we have Tebaldi as "Aida" with her supremely beautiful voice. Few will deny that in terms of sheer vocal beauty she has any peer . . . yet her acting while fair enough, is far from the Callas brand. And what about Milanov, the *Victor* "Aida", whose power is equalled by neither of the others and who has quality in her voice and is also a fair actress? You see what I mean?

The same thing could be applied to the role of Radames. Among tenors Tucker, del Monaco, and Bjoerling, which one is the best singer, actor, or combination of both? Truly among the three prime versions there would seem to be an embarrassment of riches. Of course there is also the matter of the subsidiary roles and the chorus and what kind of performance is offered by the various conductors. Too bad everyone can't have his ideal cast in one album, but that's the way it is and choose you must.

Here is my own choice and my reasoning . . . hate me for it if you will. All factors considered, among the three, this new *Angel* gets my vote. Prime factor I admit was Callas. Her portrayal was to me the most human, the most believable, even if her voice

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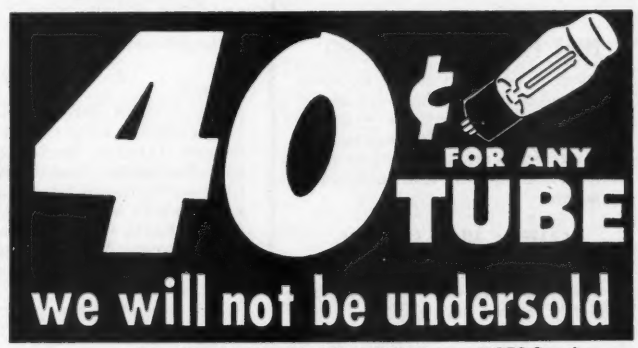

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1H5GT	3BC5	6AB4	6BC5	6J4	6U4GT	7Z4	12SN7GT	35Z5GT
1J6GT	3CB6	6AC7	6BC7	6J5GT	6U7G	12A6	12SQ7	50A5
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1L6	3Q5GT	6AF4	6BF5	6K6GT	6V3	12AT6	12X4	50C5
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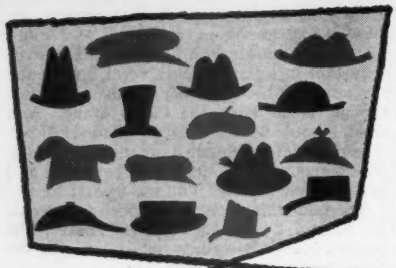

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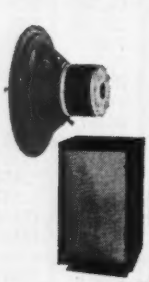

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could not match the luminous beauty of Tebaldi. For Radames I would have preferred del Monaco, but if I want Callas I must take Tucker in this role. And though he strains and bellows occasionally, there is less disparity among the tenors and Tucker's job is good enough. As far as Amonasro is concerned, I would have chosen Leonard Warren, but Gobbi has the job in this *Angel* set and runs a close second to Warren in vocalizing and about equal in acting ability. For the other roles the choices in the *Angel* were not always what I would have preferred, but the average was good enough.

Two big final factors decided me . . . by far the best conducting was that of Serafin. Erede on *London* is a good opera man, better on some works than Serafin, but neither he nor Perlea in the *Victor* set managed such a well-integrated, nicely-paced reading. The other factor was the superb sound of the *Angel* discs. The *Victor* is passably good but not outstanding, the *London* a very fine recording some years back, is showing its age. Solo work in the *Angel* set, both male and female was exceptionally well miked, the voices coming through with perfect definition. The choral and orchestral work is of very high order, with no "blast" or fusion that was noticeable. Very good string, brass and woodwind sound and the whole wrapped in live sounding spacious acoustics. Throughout the work frequency and dynamic range was very wide, and there was no audible pre- or post-echo from the grooves. Summing up . . . not a "perfect" recording by any means but for me the most convincing "Aida" now in the LP catalogue.

VERDI
LA FORZA DEL DESTINO (COMPLETE OPERA)
Renata Tebaldi, Mario del Monaco, Ettore Bastianini, Cesare Siepi, Fernando Corena, Giulietta Simionato, and others with chorus and orchestra of L'Accademia di Santa Cecilia (Rome) conducted by Francesco Molinari-Pradelli. London XLLA37. RIAA curve. Price $19.92. Four discs.

Any dyed-in-the-wool opera lover will take note of the cast in this recording and promptly shout Hallelujah! Without doubt, this is one of the most magnificent casts ever assembled for the Verdi masterpiece. If the Metropolitan were able to present as imposing a production, the *afficionados* would beat down the doors! In many ways any comparison of this recording with the *Angel* recording, its only worthwhile competitor, is similar to the situation with "Aida." But the issues here are more clear cut. True, the principals in each cast are virtually identical in "Aida" and "La Forza", but what is a good and a comfortable role for a given artist in one opera, is not necessarily so in the other opera. I'll grant that the perfect cast for any opera (that is, perfect for everybody's individual taste) has never been assembled. There are one or two roles in this recording I would prefer to see handled by others, but by and large, this is to me the most generally satisfactory group of singers I have ever heard in this particular opera, either live or recorded.

Space does not permit much analysis, but I can say that the vocalizing and general characterization of del Monaco as Don Alvaro is outstanding, definitely one of the best things he has done. Tebaldi is a golden-voiced and utterly convincing Leonore, Bastianini as Don Carlo exhibits a richly resonant voice, beautifully controlled and he sounds better here than in any other role I can remember. Siepi as Padre Guardiano is in particularly fine voice, its deep richness wonderfully projected. And one's regard for Simionato grows the more she is heard. As Preziosilla she is superb, for her voice is really lovely, and acting really good. Many of the subsidiary roles are handled by singers of considerable artistic stature and, on the whole, the results are highly gratifying.

Old Maestro Pradelli is in charge of proceedings and, as usual, he elicits some wonderful playing from his orchestra, maintains a good balance between orchestra and chorus, and generally keeps things running along smoothly. Except for a little too fast a pace in the final act, his tempi are all quite reasonable. Most outstanding in this album is the sound, which is one of the most satisfactory recordings ever made by *London*. The balance is nigh perfect, the acoustics are spacious but not overdone, frequency range and dynamics are as wide as most symphonic material. The voices have a pure clear definition that makes for easy intelligibility, and the orchestra is good sounding too, with bright string tone, crisp brass and percussion. Pre- and post-echo, the curse of many an opera recording is almost totally absent here. All in all, this is one of *London's* most stellar achievements in recorded opera. Highly recommended.

ROSSINI
FIVE OVERTURES
London Symphony Orchestra conducted by Pierino Gamba. London LL1366. RIAA curve. Price $3.98.

Not too long ago Gamba was a child prodigy in a strange field . . . conducting. Dismissed by many as mere sensationalism, the young Mr. Gamba has evidently weathered the storm and if we can judge by his picture on the album cover, he is considerably matured. He conducts the "Siege of Corinth," "Il Signor Bruschino," "La Cenerentola," "Tancredi" and last, but not least, "William Tell" overtures. He is no slouch either . . . he knows how to control his forces quite well and his readings are quite acceptable. Of course he doesn't equal the refinement and the fire and dash that Toscanini and others have brought to these scores, but that's hardly a fair comparison. Main advantage here is the resplendent sound, by far the best available for these works. Nice incisive strings, brilliant brass, and some notably accurate percussion combine with the fine acoustics for exceptional realism. If you have kids who like the "Lone Ranger," and you have a good hi-fi system, you can now have the dubious pleasure of playing for them the most hi-fi "William Tell" in existence!

CHOPIN
LES SYLPHIDES
STRAUSS, JOHANN, JR.
GRADUATION BALL
Boston Pops Orchestra conducted by Arthur Fiedler. Victor LM1919. RIAA curve. Price $3.98.

A happy combination this, as played by the inimitable Boston Pops. "Les Sylphides" has been done many times before, a notable version being that of Desormiere on *London*, and while that was a splendid recording and a good reading, we'll have to give the blue ribbon to Fiedler and his men. They are blessed with a more modern and felicitous sound, better acoustics for one thing and cleaner string tone for another. Main point of superiority however is the Boston players who are quite a few rungs above the men of the Paris Conservatory Orchestra. With "Graduation Ball," Fiedler has stiffer competition from Fistoulari on *London*, in both matters of sound and performance. The *London* was a very good recording and this just squeaks by as somewhat better in detail and wider in dynamics. Performance-wise Fiedler hurries things more than Fistoulari and the thing that saves him and makes it an exciting reading is the ability of his Boston men to play fast while keeping everything in nice crisp

definition. Another good disc for easy summer listening.

Tape Review

DVORAK
SYMPHONY NO. 5
Philharmonic Symphony Orchestra of London conducted by Artur Rodzinski. Sonotape SW3002. 7" reel, half-track, 7½ ips. NARTB curve. Price $8.95.

This is a particularly fine symphonic recording on a *Sonotape* and on comparison with the *Westminster* original, it is easy to discern how much better is the tape and why it is worth the difference in price. The string tone which was quite good on the disc seems almost "shrieky" when you hear the bright but smooth tape sound, the trumpets and trombones, clear in their enunciation on the disc, really speak out in huge forceful brazen tone on the tape. Woodwinds have a purity of tone and an almost palpable liveness and the percussion which has always been a *Westminster* specialty and was excellent on the disc, is really spectacular here, with a bass drum of noble proportions and cleanness, and tympani which sound out with great weight and sharply accented precision. The London Symphony under its *nom-de-plume*, does a superb job under the expert urgings of Rodzinski. The Dvorak work has long been one of his specialties and he acquits himself well here in a fast-paced rather taut reading that generates plenty of excitement. Really a performance good enough to stand beside such notable efforts by Kubelik and Toscanini. A fine performance and a magnificent sound add up to one of the most satisfactory recorded tapes now available. —30—

Hi-Fi—Audio Equipment

(*Continued from page* 84)

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Cables f/BC-375/BC-191, PL-61, 64 or 59, each end: Ea. 2.75
BC-442 Antenna Relay Box—w/Cond.....New: 2.95
BC-453 Trans.: 67-74 MC. 20 Watt. 16 Tubes.U: 16.95
BC-603 Receiver FM—20-28MC.....Used: 29.95
BC-604 Trans.: FM—30 Watt. 20-28 MC..Used: 18.95
BC-500 Trans. & Rec.: 25 Watt, 20-28 MC.New: 59.50
BC-617 Receiver Only. 30-40 MC w/Dyn..Used: 24.95
BC-654 Transceiver: 3800 to 5800 KC.....Used: 34.95
BC-709 Amplifier—Battery Operated.....New: 1.95
BC-745 Transceiver: 3 to 6 MC.....Used: 14.95
BC-924 Trans. FM—30 Watt. 27-38.9 MC. New: 24.95
BC-966 IFF—160-211 MC. 13 tubes.....Used: 5.95
BC-1158 Trans.: 50 Watt. 53.3-95 MC.....New: 39.95
RM-12 Radio-Telephone, Remote Control..Used: 19.95
RM-13 Telephone, Remote Control.N: $24.95; U: 19.95
RM-21 Remote Control Box for BC-669..... 4.95
SCR-625 Mine Detector—Reconditioned..... 39.95

SCR-522 Transceiver: 100-156 MC....Used: $34.95
Rec. Chassis only.....w/Tubes: 19.95
Less Tubes: 9.95
Trans. Chassis only.....w/Tubes: 22.50
Less Tubes: 9.95
Schematic & Conversion Information only.. 2.50

ID-60/APA-10 Panoramic Oscilloscope....New: 49.50
TBY Transceiver: 20-80 MC. 4 Bands, w/Tubes.U: 19.95
R1/ARR-1 Receiver—Converts to 2 or 6 Meters.. 2.95
RT-7/APN-1 Altimeter—440 MC.....Used: 9.95
RT-34/APS-13 Transcvr. Comp. less tubes...U: 3.95
R-74/CRW-2 Receiver—53-88 MC—6 Tubes..N: 9.95
TG-34A Keyer: 115/230 V 50-60 cy. w/Tubes.N: 16.95
TG-10 Keyer: Complete w/Tubes.....Tested U: 14.95
T-121 Transmitter—3-4 MC with Coder..... 7.95
Range Beam Filter, Navy Type $1.95; FL-8 Used: 1.49
EE-8 Field Telephones—Checked .....Used: 14.95
BD-72 Portable 12 Line Switchboard.....Used: 39.95
Sound Powered Head & Chest Set—Checked.... 3.95
Sound Powered Head & Handset f/Mark II. Used: 2.95

TS-9 Handset w/Switch—No Plugs. N: $5.95—U: $ 3.95
TS-13 Handset w/Switch. PL-68 & PL-55. Used: 5.95
TS-15 Handset w/Switch. PL-68 & PL-55. New: 7.95
T-17 Microphone—Used. Checked..... 3.95
HS-30 Headset—Hearing Aid Type—L.N..... 1.50
CD-874 Cord—f/HS-30—Low Imp., w/PL-55.U: .59
CD-515 Cable for BC-669..... 2.75
CD-605 Cord—F/HS-30—High Imp. w/PL-54.N: .79
CD-307 Cord—w/PL-55 & JK-26.....U: .59
CD-318 Cord—2/PL-68, JK-48, & SW-141...U: .89
GN-45 Handcrank Generator w/Legs & Seat.. 9.95
R-4/ARR-2 Receiver—234—258 MC. w/Tubes.U: 4.95

BC-1206 Receiver: 200 to 400 KC.....New: $9.95
BC-1206 Receiver/Less Tubes (200-400 KC).U: 3.95
12 Volt Dynamotor for BC-1206..... 4.95

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MP-22 Mast Base—Swivel type.....$2.95
MP-S-33 Mast Base—Spring type..... 5.95
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Mast Sections for above bases—MS-49 to 53...ea. .50

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(NAVY—274)	USED:	NEW:
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520—1500 KC Receiver	$14.95	19.95
1.5—3.0 MC Receiver	9.95	
6—9 MC Receiver	4.95	
100—156 MC Receiver (R-28)	10.95	
2.1—3 MC Transmitter	5.95	7.95
3—4 MC Transmitter	6.95	
4—5.3 MC Transmitter	4.95	
7—9 MC Transmitter	4.95	7.95
100—156 MC Transmitter	14.95	
BC-456 Modulator	2.95	

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12	230	90	PE-133	4.95	6.95
12 or 24	540	450	DA-12		14.95
12 or 24	230	100	DA-14		8.95
14	220	70	DM-24	4.95	7.95
14	1030	260			
	515	215	DM-42	4.95	9.95
14	375	150	BD-83	3.95	4.95
14 VDC	330	150	BD-87	3.95	5.95
14	250	50	DM-25	6.95	8.95
14	1000	350	BD-77	14.95	29.95
24	250	60	PE-86		8.95
28	1000	350	PE-73	8.95	

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16 Volt 35 Amp. 115/230....$24.95; 24V—1 Amp 1.50
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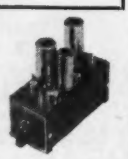

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WRITE FOR LITERATURE

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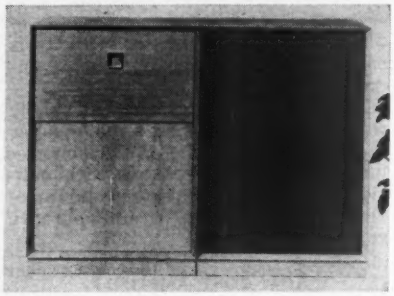
enclosures and hi-fi equipment cabinets to its "Cabinart" line.

The Models 27 and 28 enclosures are available as "do-it-yourself" kits. The equipment cabinet will house record changer or player, tuner, and amplifier. The matching bass reflex cabinet has a baffle area of 6 square feet and



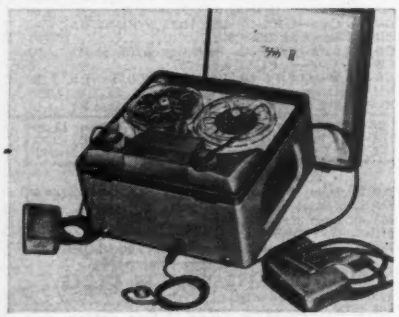
stands 35" high, 23½" wide, and 17½" deep. While the equipment cabinet duplicates the external dimensions of the speaker housing, the interior is divided into two compartments.

Both enclosures are of white pine plywood, ¾" thick. The grain on this wood lends itself to a natural blonde finish or the cabinets may be painted or stained to suit the assembler.

OFFICE TAPE RECORDER

Telectro Industries Corp., 35-16 37th Street, Long Island City 1, New York has developed a compact, lightweight tape recorder which has been especially designed for office dictation and playback.

The Model 556R has a separate microphone which permits private recording, a separate foot pedal for instantaneous start and stop, playback, backspacing, erasing and editing, rewinding, and listening. Playback can be heard through an internal speaker



or a separate headset. The volume control turns the machine on. Operation is completely automatic.

The unit will record up to 1 hour on a 5" reel of magnetic tape. Smaller reels can be used for shorter messages. The recorded tapes can be filed or mailed.

NEW CERAMIC CARTRIDGE

The electronics division of *Elgin National Watch Company* has entered the high-quality ceramic cartridge market with a new line of original equipment and replacement units.

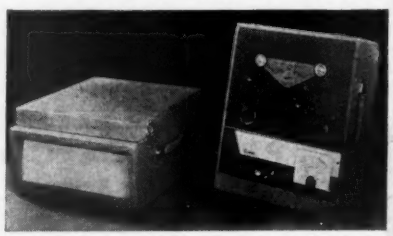
The new line will be marketed by the company's California affiliate, *American Microphone Company*. A new turnaround "throwaway" cartridge highlights the new line. It uses an osmium needle for both 33⅓ and 45 rpm play and a newly-styled sapphire needle for 78 rpm recordings of both ancient and recent vintage.

A positive "snap-in" action automatically locates the single needle replacement in proper alignment without the use of tools.

TAPE DECK HOUSING

Fenton Company, 15 Moore Street, New York 4, New York is currently handling a new carrying case which is designed to accommodate the *Brenell* tape deck and preamplifier distributed by the firm.

The case comes complete with mounting hardware. It is tan, leatherette covered, modernistically styled lightweight case with white plastic perforated grilles on the front and back. The front is slanted to about 80 degrees, thus permitting the use of the preamplifier combination either hori-



zontally or vertically. This tilt makes the loading of tape a simple drop-in operation.

The three items—tape deck, preamp, and case—are available separately.

MICROPHONE SWITCH

Atlas Sound Corp., 1451 39th Street, Brooklyn 18, New York has announced the availability of a new microphone switch, the Model FS-1.

Although designed primarily for foot operation, its compact size makes it suitable for hand operation on table top, switchboard, desk, etc. It is completely shielded and firmly grounded for noise-free operation.

The Model FS-1 is supplied as a "press to open" switch. The normal, closed position shorts the microphone. Depression of the switch removes the short from the circuit and the mike becomes operative.

The company will supply additional details and prices on request.

PUSH-BUTTON CHANGER

Audiogersh Corporation, 23 Park Place, New York 7, New York has recently introduced a new model of the "Miracord" record changer which features five push-buttons for completely automatic operation.

The newest addition to the earlier model consists of a stop button which arrests the changer at any point in its operation and restores the entire mechanism to a neutral position from which the equipment can be put back

into operation by pushing the "start" button.

The tone arm never has to be touched or lifted from the record and whatever records are on the "Magic Wand" spindle can remain there and do not have to be discharged to put the unit at the rest position.

A data sheet on the five-button "Miracord XA-100" changer is available from the company on request.

AUDIO CATALOGUES

CABINART LINE BROCHURE

The "Cabinart" division of *G & H Wood Products Co., Inc.*, 99 North 11th St., Brooklyn, New York has released a pocket-size catalogue detailing its extensive line of cabinets for speakers and equipment.

Pictured and described in this 34-page booklet are kits and ready-assembled units in finished and unfinished form. The line is extensive enough to meet the equipment housing requirements of almost any audiophile.

A free copy of this brochure is available for the asking.

AMERICAN MICROPHONE LINE

The Electronics Division of *Elgin National Watch Company* has just released a new 20-page catalogue covering its extensive line of *American* microphones and phonograph cartridges.

Styled in yellow and black to match the new packaging of the product line, the catalogue lists prices, specifications, and characteristics of each item currently being marketed by the division.

Highlighting the catalogue is a section devoted to the new ceramic "turnover" and single needle phonograph cartridges recently added to the line.

Copies of this catalogue are obtainable from the company at Elgin, Illinois. Request Catalogue No. 47. —30—

Single-Gun Color Tube

(*Continued from page 63*)

mainder of the receiver outlined in heavy solid lines is shown in four separate sections: the index amplifier, the "pilot" carrier oscillator and color mixers, the writing frequency amplifier, and the horizontal sweep and high voltage.

The horizontal sweep-high-voltage section is similar to monochrome practice. Some details include the use of a pair of 6CD6 tubes for horizontal drive, and a special high-perveance diode, the L-1379, as the damper. The 30 kilovolt supply is obtained by a voltage doubler using 1B3's.

To aid in maintaining horizontal sweep linearity with changes in line voltage, and to maintain a nearly constant picture height, it appears advantageous to derive the plate supply voltage for the horizontal and vertical oscillators from the regulated energy in the horizontal system.

Vertical dynamic focus only is used in this receiver; for this, a vertical frequency parabola is applied to a focus control tube. The high-voltage supply must have two regulated outputs in order to maintain optimum focus, horizontal sweep operation, and index. This has been accomplished by use of two all-glass gas regulators.

The mixer unit consists of two tubes whose triode sections accomplish nearly all the color signal processing required by the receiver. The functions of this section are to generate an unmodulated "pilot" frequency carrier, and to transfer the chrominance modulation to a second "pilot" frequency carrier. The latter signal is mixed with the amplified index information derived from the CRT to form a chrominance-modulated writing signal which includes the positional information of the index signal.

The chassis shown in Fig. 5 contains the complete receiver including the power supply. This receiver, as a developmental type, does not use an excess of dual-section tubes, yet its complement is only eight tubes more than a shadow-mask receiver containing the same non-display circuitry. In the foreseeable future this differential may be not more than five tubes. Against this disadvantage are the potential advantages of an electron optical system requiring only two alignment adjustments and a cathode-ray tube completely free from static and dynamic white balance, and magnetic field problems. —30—

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1A5GT	1R5	6A5G	6BA7	6J8G	6U8	7X6	14A7
1A6	1S4	6A7	6BC5	6K5GT	6V6GT	7Y4	14Q7
1A7GT	1S5	6A8	6BD5GT	6K6GT	6W4GT	7Z4	19BG6G
1AB5	1T4	6A8GT	6BE6	6K7	6W6GT	12A6	19J6
1AX2	1T5GT	6AB4	6BF5	6K7GT	6X4	12AT6	19T8
1B3GT	1U4	6AB7	6BG6G	6K8G	6X5GT	12AT7	24A
1B4P	1V	6AC5GT	6BH6	6K8GT	6Y6G	12AU6	25AV5GT
1B5	1V2	6AC7	6BJ6	6L6GA	7A4-XXL	12AU7	25BQ6GT
1B7GT	1V5	6AF4	6BK5	6L7G	7A5	12AV6	25L6GT
1C3	1X2A	6AG5	6BK7A	6N7	7A6	12AV7	25Y5
1C5GT	2A5	6AG7	6BL7GT	6P5GT	7A7	12AX7	25Z3
1C6	2A6	6AH4	6BN6	6Q7	7A8	12AY7	27
1C7G	2A7	6AH6	6BQ6GT	6Q7GT	7AG7	12BA6	32L7GT
1C8	2B7	6AJ5	6BQ7A	6R7	7AH7	12BA7	35A5
1D5GP	3A4	6AK5	6BY5G	6S4	7AJ7	12B4	35B5
1E5GP	3A5	6AL5	6BZ7	6S7G	7B4	12BE6	35C5
1E8	3A8G1	6AL7GT	6C4	6S8GT	7B5	12BH7	35L6GT
1F7G	3B7	6AQ5	6C5GT	6SA7	7B6	12BY7	35W4
1H4G	3D6	6AQ6	6CF6	6SA7GT	7B7	12J5GT	35Z3
1H5GT	3Y4	6AQ7GT	6CG6	6SC7	7B8	12K8	35Z5GT
1H6GT	3Q5GT	6AS5	6CB6	6SG7	7C4	12SA7	45Z5GT
1J6GT	3S4	6AT6	6CD6G	6SH7GT	7C5	12SA7GT	50A5
1L4	3V4	6AU4	6CS6	6SJ7	7C6	12SG7	50B5
1L6	5AX4	6AU5GT	6D6	6SJ7GT	7C7	12SH7	50C5
1LA6	5T4	6AU6	6E5	6SK7	7E5	12SJ7GT	50L6GT
1LC5	5U4G	6AV5GT	6F5GT	6SK7GT	7E6	12SK7	70L7GT
1LC6	5V4G	6AV6	6F6GT	6SL7GT	7F7	12SK7GT	75
1LD5	5X4G	6AX4	6F7	6SN7GT	7F8	12SL7GT	77
1LE3	5Y3G	6AX5GT	6G6G	6SQ7	7G7	12SN7GT	78
1LG5	5Y3GT	6B5	6H6GT	6SQ7GT	7J7	12SQ7GT	80
1LN5	5Y4G	6B6G	6J5	6SR7	7K7		
1N5GT	5Z3	6B7	6J6	6SR7GT			

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12LP4	12.95	16DP4	18.50	17BP4	19.00	20CP4	24.00
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Repairing Oscilloscopes

(*Continued from page* 68)

input of the horizontal amplifier. Connect the "hot" lead from the vertical input of the scope to various points in the horizontal amplifier chain. A vertical line will be seen on the scope when the "hot" lead connects to a circuit point at which signal is present. If a vertical line indication is obtained at some circuit point, say the plate of a tube, but is not obtained at a directly succeeding circuit point (the grid of the next tube), the trouble lies between the two points.

2. Apply the test signal through a .1-μfd. capacitor to various points in the horizontal chain, starting with the horizontal deflection plates and working backward. A horizontal line will be seen on the CRT screen if the circuit between the point to which the signal is applied and the horizontal deflection plates is operating normally. The first circuit point where such a line is not produced (when the test signal is applied to the point) is the approximate site of the trouble. Voltage, resistance, and capacitor bridging or substitution tests should locate the faulty component in short order.

Keep in mind that passage of a test signal through the horizontal oscillator does not necessarily prove that the stage is operating normally. A tube can have enough gain to pass a signal with slight amplification, and yet may be unable to oscillate. In most modern scopes, the horizontal oscillator is a vacuum-tube multivibrator type. The same troubleshooting techniques used for checking a comparable sweep oscillator in a TV set may be employed to test this circuit.

Other Troubles

When a normal horizontal sweep can be obtained on the scope screen, but it is impossible to obtain a stable waveform by suitable manipulation of the sync control, sync trouble is present.

On internal sync, some of the signal whose waveform is to be observed on the scope is fed back to the horizontal oscillator, to sync the latter. In some instances, an amplifier is employed to increase the amplitude of the sync signal as well as to shape it properly; in others, the signal is fed back without amplification. If a sync amplifier tube is used, and trouble is present, try a new tube. If this doesn't cure the trouble, check the circuit through which the sync signal is fed from the vertical section to the horizontal oscillator. Remember, in many cases proper lead dress is important to the correct operation of the sync system (as well as the vertical amplifier).

Hum in the sync system may be the cause of unstable waveforms. If the same sync performance is obtained when the sync switch is on the "internal" as on the "line" setting, hum is probably present (normally, better sync performance should be obtained on the "internal" setting of the switch). The hum symptoms are generally due to cathode-heater leakage in a tube; in cases where the scope has been built by the owner or improperly serviced, faulty lead dress is likely to be the cause of hum.

The servicing of the vertical section of the scope depends on the nature of the symptoms present. If the section is completely dead, *i.e.,* no vertical deflection can be obtained, check the tubes in this section. If no faulty tube is present, apply an a.c. test signal to various points in the vertical circuits. The method is similar to the one used in troubleshooting the horizontal stages, except that a sine wave rather than a horizontal line will be seen on the screen when the circuit section between the point where the test signal is applied and the vertical deflection plates is normal. After the defective stage has been located *via* this signal substitution procedure, voltage, resistance, and related checks should readily locate the faulty component.

Other common conditions (besides inoperation) that may be produced by defects in the vertical amplifier section include improper frequency response and hum. Tests for improper frequency response are called for when application of a normal test signal—say, a TV horizontal sync pulse—to the vertical input of the scope produces a waveform whose shape and/or amplitude is incorrect. Hum in the vertical section will cause the horizontal trace to be wavy even when the vertical input leads are shorted together. Hum is usually due to heater-cathode leakage in a tube, or improper lead dress (particularly in the first stage of the vertical section).

To check the frequency response of the vertical amplifier, the same techniques used in checking the video amplifier of a TV set may be applied. A response check with a square-wave generator is the best test. When a square-wave generator is not available, the composite video signal present at the detector of a good TV set can be used. The horizontal sync pulse serves as the test signal in this case. Since the repetition rate of this signal is 15,750 cps, and since approximately 20 harmonics of the fundamental frequency must be present to make a good square wave, proper reproduction of the horizontal sync pulse by the scope will test the response of the latter up to 300 kc. The service technician must be familiar with the frequency limitations of his scope when making such a test. That is, he must know what the horizontal sync pulse will normally look like on the screen of his scope, when the latter is operating correctly. Before a particular TV set is used as the source of the test sync pulse, make sure that the receiver is in good working order and its i.f. system is properly aligned. The station being received must be tuned in correctly. If these precautions are not observed, the sync pulse seen on the

scope may show signs of poor frequency response even when no defect exists in the scope.

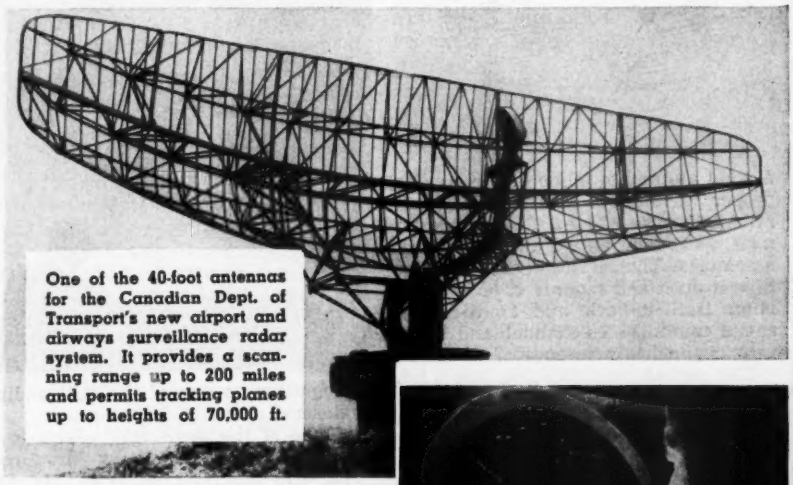
Faults to look for in the reproduced square wave include: 1. Tilting at the top of the waveform with the trailing edge shorter than the leading edge (see Fig. 5A). This characteristic indicates poor low-frequency response (or excessive phase shift). 2. Rounding of the front corner of the waveform (Fig. 5B); such a symptom points to poor high-frequency response. 3. Overshoot and ringing, due to excessive high-frequency response (Figs. 5C and 5D). Check especially all coupling capacitors and plate load resistors whenever poor high- or low-frequency response is encountered. Ringing may be due to a gassy tube.

Be sure to check the scope probe (if one is used) at the same time the scope is being checked, since a defect in the probe can introduce the same symptoms as a defect in the scope's vertical amplifier. (A low-capacitance probe must be adjusted for the scope it is used with; a trimmer is provided in such a probe, to correct for tilt or overshoot.)

When response checks of the individual vertical stages have located the faulty one, conventional voltage, resistance, and capacitor bridging or substitution tests will reveal the defective component.

Table 1 is a synopsis of the various tests discussed in this article. -30-

RAYTHEON TO INSTALL CANADIAN RADAR NET



One of the 40-foot antennas for the Canadian Dept. of Transport's new airport and airways surveillance radar system. It provides a scanning range up to 200 miles and permits tracking planes up to heights of 70,000 ft.

Operator views image on the Raytheon radar screen. Geographic indications which permit operator to pinpoint positions of planes, are electronically superimposed on face of radar scope by flipping switch. New radar simplifies detection of planes because of system's built-in ability to select and reflect only moving objects, while filtering out fixed objects such as buildings, mountains, etc.

A CONTRACT for a coast-to-coast commercial airways radar system has been awarded to Raytheon by the Canadian Government as part of its comprehensive program of transcontinental airport development and air traffic control, specifically aimed at equipping Canada's airways for the coming of the jet age.

The equipment, which will be installed at 15 major airports, consists of Raytheon's newly-developed AASR units which will permit each airport to track large commercial airliners within a radius of up to 200 miles. Because Canada's principal airports, with one exception, are no more than 400 miles apart, the overlapping patterns of radar surveillance will provide almost coast-to-coast coverage.

The new equipment permits the operator to select either linear or circular polarization of the radar signal, depending upon weather conditions. The circular polarization technique is much like putting "english" on a billiard ball. When the "twisting" microwaves strike the storm cloud, millions of spherical raindrops bounce them back to the antenna with a reverse twist. Their path to the receiver is blocked by an electronic filter so that they cannot register on the radar scope.

When the microwaves strike the irregular surfaces of a solid object, such as a plane, many of them return to the antenna, retaining their original twist. Thus they pass unhindered through the electronic filter to the receiver and register as targets on the scope.

Another feature of the new system is "moving target indication" which selects only moving objects to be reproduced on the screen. Reflections from buildings, mountains, and other intervening obstructions are filtered out.

An electronically generated map of the territory over which the plane is flying can be superimposed on the face of the scope and become visible merely by flipping a switch.

Delivery of the new units will begin early in 1958. -30-

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Almost without exception, makers of the finest high-fidelity sets depend upon Tung-Sol Audio Amplifier Tubes to help deliver the performance expected of their products.
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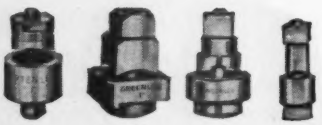

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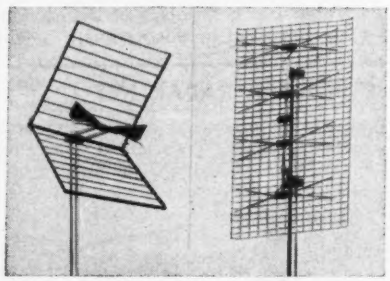
Antenna News

TWO NEW U.H.F. ARRAYS

JFD Manufacturing Co., Inc., Brooklyn 4, N. Y., announces the addition of two new antenna arrays to its u.h.f. line.

The new all-aluminum corner reflector model UHF410 features permanent rust and corrosion resistance.



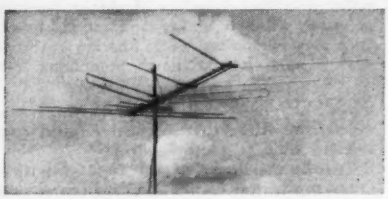
A solid aluminum inline dipole creates proper wavelength relationships with reflector assemblies for maximum u.h.f. gain. The entire unit is factory assembled. The service technician just flips it open and mounts it on a mast. High front-to-back and front-to-side ratios minimize co-channel and adjacent channel interference.

The second new addition, the u.h.f. 4-Stack Bowtie Model No. UHF202 features a new super-rigid, 1-piece pre-assembled design. The response of this antenna may be peaked to the desired u.h.f. channels. An accurately spaced and cut phasing harness creates maximum u.h.f. stacking gain ideal for fringe area reception.

NEW FRINGE ANTENNA

Brach Manufacturing Corp., 200 Central Ave., Newark 3, N. J., is introducing a new broadband v.h.f. antenna, the "3V", model 5603. This antenna has been designed to perform as a high-gain u.h.f. antenna in primary areas and as a fringe antenna for v.h.f.

Manufacturer's gain curves show an average gain of 7 db on the low



v.h.f. channels and 15 db on the high channels. Sharp directivity is claimed.

The antenna features aluminum construction and snap lock design.

TWO HIGH-GAIN ANTENNAS

The Finney Company, 4612 St. Clair Ave., Cleveland, Ohio, announces the addition of the models B-6 and B-7 to its "Finco Geomatic" antenna line. Both of these antennas give high gain over a broad band, and feature high front-to-back ratio.

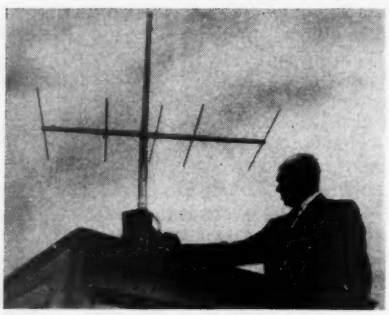
The model B-6 antenna uses four coaxial capacitors in one folded dipole, causing the dipole to act as if it were one length on the low band and another length on the high band. In addition, a low-band reflector, a high-band colinear reflector, and a combination director further increase the gain and directivity.

The model B-7 features two 3-element colinear directors and an inductance-tuned low-band director in addition to the elements used for the B-6.

These antennas are shipped either single bay or stacked.

ANTENNA PIONEER HONORED

Telrex Laboratories, Asbury Park, N. J., and its president, Michael D. Ercolino, were the subjects of a recent story in a New Jersey business magazine. The company itself received

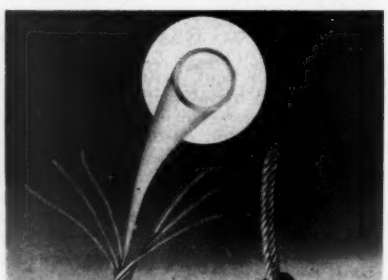


recognition as one of the outstanding industrial firms of New Jersey.

Some of the pioneering advances in the antenna art made by Mr. Ercolino, who was referred to as "Mr. Antenna", were described.

TV TRANSMISSION WIRE

Channel Master Corp., Ellenville, N. Y., has introduced a new television transmission wire called "Copper-



Jac". This new twin-lead features conductors of Copperweld, a special type of wire which has a core of steel and a coating of pure copper. This results in conductors which have extraordinary high strength as well as high conductivity.

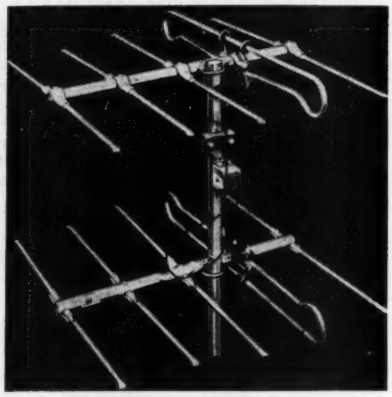
"Copper-Jac" is insulated in pure polyethylene and is available in three colors, brown, silver, and black. It contains 7-strand conductors of No.

28 or No. 30 Copperweld wire. This lead-in is also furnished with a choice of web thicknesses and comes in 1000-foot lengths, either on a spool or in a "Feeder-Pak".

2-METER AMATEUR ANTENNA

Skysweeper, Inc., McHenry, Ill., now has available a low-cost 2-meter amateur radio beam antenna, the model HM2-10AK, 5-over-5 yagi, sold by distributors for $12.95 net.

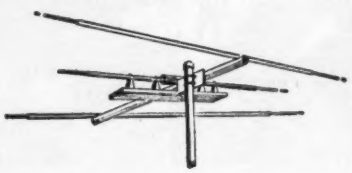
This antenna is cut to 146 mc. and covers 144-148 mc. The s.w.r. at reson-



ance is 1.1 or less. All interconnecting harness is 1 kilowatt twin-lead, terminating in a SO-239 coaxial socket mounted in a weather-resistant connector box. The antenna can be fed from any length of 52-ohm coaxial cable. It can be mounted vertically or horizontally.

10-METER ROTARY BEAM

Mosley Electronics, Inc., 8622 St. Charles Rock Road, St. Louis 14, Mo., has just announced a new high-gain, low-cost, ten-meter rotary beam antenna. The "Super Ten" is a three-



element beam using ½ wavelength director and reflector elements teamed with a shortened driven element to permit the use of a coupling transformer. This coupling system is simple, convenient, and exceptionally efficient as a match for 52-ohm line.

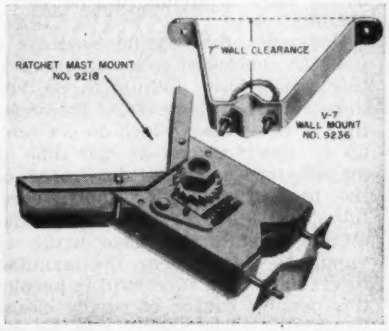
Performance figures on the new antenna include: 7.9 db gain, 20 db front-to-back ratio, 1.2 to 1 s.w.r. at resonant frequency. The maximum element length is 17 feet, 3 inches; the boom is 8 feet, 4 inches. The weight is 20 pounds.

MAST MOUNTING ACCESSORIES

Television Hardware Mfg. Co., Rockford, Ill., has two new products: a TV antenna mast mount with a ratchet grip and a wall mount providing 7-inch wall clearance.

The new "Telco" ratchet mount can be used on any type of chimney or similar support where a strap is employed. It will fit all masts up to 1¾" in diameter. It is made of heavy gauge steel, double plated to prevent rust, and is supplied with 24 feet of strapping.

For installation, the service technician just slips both ends of the strap

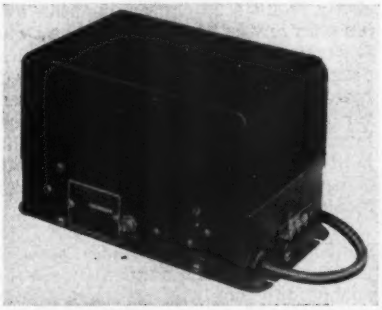


through the ratchet bolt slots and then uses a wrench to tighten the strap.

The new TV antenna mast wall mount is the "Telco" model "V-7". It is constructed of heavy gauge steel, zinc plated, and comes completely assembled.

IMPROVED V.H.F. BOOSTER

Blonder-Tongue Laboratories, Inc., 526-536 North Ave., Westfield, N. J., is delivering a greatly improved broadband v.h.f. amplifier, the model CA-1. This booster now features over 26 db gain on the low band and 24 db on the high band, according to the manufacturer. It is also claimed that the response curve of the unit is flat



within ±2 db over the entire v.h.f. band.

The total peak output of the four-triode tube circuit is .7 volt for 75 ohms and 1.4 volts for 300 ohms. A built-in 14 db gain control is included. The fused power supply operates from any 117 volt, 60 cycle a.c. source.

ANTENNA SALES AID

In order to help promote the sale of the company's "Venus" indoor antenna *JFD Manufacturing Co., Inc.*, 6101 16th Avenue, Brooklyn 4, New York has prepared an attractively lithographed, three-color easeled display.

Designed to be used in either a show window or on a counter, the merchandiser is said to stimulate traffic sales of indoor antennas. The merchandiser is being supplied without charge by the company or its distributors. —30—

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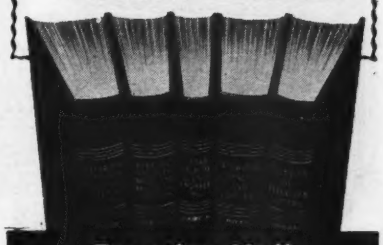

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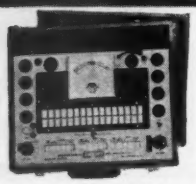

Fastest Dynamic Tube Tester made, yet it's fully flexible for all receiving types, new and old. The set-up time is actually less than the warm-up time of the tube. New Variable Sensitivity Shorts Test shows leakage up to 2.0 megohms. Metered plate current shows tube condition. Meter calibrated in Good-Bad as well as Percent of relative micromhos. Automatic Line Voltage Indicator, Life Line Indicator, New Zig Zag Roll Chart locates tube types much faster, TV types separated for even faster locating.

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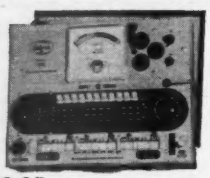

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A good, basic tube tester, with plug-in accessories for performing a wide variety of additional tests. Accessories may be added any time, permit testing tubes for filament current and high resistance shorts, as well as checking selenium rectifiers. Lever action shows which pins are connected. Sensitive shorts test. Line Voltage Indicator. A tremendous value.

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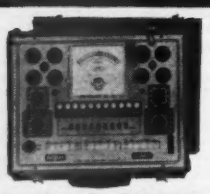

Employs famous Jackson Dynamic principle, applying separate voltages to each tube element. High voltage power supply for most accurate tests. Improved switching system gives simplified, fast operation. Filament voltages for the very latest TV types. Fully portable case finished in harmonizing gray and green, tough plastic fabric. Built-in roll chart, with free replacement service for one year.

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16-18 S. PATTERSON BLVD., DAYTON 2, OHIO
In Canada: The Canadian Marconi Company

The Tube Racket

(*Continued from page* 41)

to the manufacturer for a new tube. If this practice is followed, there will be no tubes available to the illegal operator.

One point that should be clear is that the rebranded tubes discussed in this article have nothing to do with so-called manufacturer's "seconds," that is, those tubes which do not come up to specifications at the time of manufacture and are discovered on the production testing line. These tubes are destroyed in the plant and although rebranders have made attempts to obtain them, the manufacturers have been successful in keeping this possible source of supply closed. Rebranded tubes should also be distinguished from tubes which are sold as surplus. These, in almost all cases, are new tubes obtained from electronic equipment manufacturers who may have gone bankrupt or out of business, or have changed the design of their equipment, had an overrun, etc. Since equipment manufacturers obtain new tubes from tube manufacturers at extremely low cost, they, in turn, can resell these tubes, when necessary, at far below list price. Thus, such tubes are resold to users at bargain prices. These, however, are good tubes and this type of operation is strictly legitimate. —30—

BRASS POUNDERS' HAMFEST

THE South Hills Brass Pounders and Modulators, Inc. will hold its 18th Annual Hamfest Sunday, August 5th at Totem Pole Lodge, South Park, Pittsburgh.

The affair will start at noon with entertainment provided for the whole family. Those registering before July 21st will be charged $1.50 a ticket with $2.00 collected at the gate.

Reserve with S. J. Zolinas, W3QWW, 423 Parkwood Road, Pittsburgh. The club station, W3PIQ, on 29.2 mc. will be used to "zero" the mobiles. —30—

The Easy Way

(*Continued from page* 39)

builds friendship and understanding on an international as well as a national basis, but because it is an all-age avocation. Long after a man has been advised to taper off on his tennis and golfing activities, he can still continue his "armchair" traveling *via* the airwaves.

Bill's interest in hamming led directly to his studying engineering and his stint on the MARS station at Duke is earning him time credit for his undergraduate Air Force training. Needless to say, his Dad is well pleased, for although he is, himself, a free-lance photographer by profession, his hobby has such a hold that it is gratifying to know that the indoctrination "took" with his son.

The author, currently president of the Sarasota Amateur Radio Association, invites visiting hams to look in on one of our monthly meetings if they are in the neighborhood. We meet the second Thursday of each month at the Sarasota County Courthouse. —30—

Bill Steinmetz, W4TFP, at mike of W4YI's mobile transmitter during the ARRL's 1955 field day contest. They placed third in the mobile category during 24-hour meet.

Interior of W4YI and W4TFP's ham shack with the author at the mike. Note the great circle map, the 24-hour clock, and all the other operating conveniences.

Protection System

(*Continued from page* 54)

plies the necessary voltage (obtained from the main chassis) to operate the test motor.

With such an arrangement, the line between the guard panel and the main chassis may be well over a mile in length.

Special Features

Since only two wires, plus an earth ground, are required for the operation of the system, an ordinary leased telephone line may be used to connect the guard panel and the main chassis. In an emergency, permission can generally be obtained from the local telephone company to use an existing connection between a protected area and the guard room.

Excessive air turbulence may cause a shift in frequency of the ultrasonic waves in the same manner that a moving body does. Because of this, air turbulence resulting from even a tiny flame will cause an alarm. The protection system thus serves to give an alarm in case of fire as well as protection against an intruder.

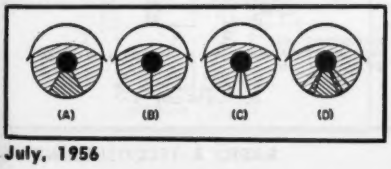
Installation Techniques

The ease of installation can be best emphasized by the following summarized installation procedure:

1. The carrying case is opened and the guard panel and main chassis removed.
2. The main chassis is placed near a convenient power outlet and connected to an earth ground.
3. The two halves of the carrying case are separated and placed against opposite walls of the room to be protected.
4. The special plug-in cables supplied for interconnecting the units are connected.
5. The main chassis is turned on and sensitivity adjusted.
6. The guard panel is taken to the guard room, and the coil of line supplied unrolled and used to connect the guard panel and the main chassis (both ends of the line are "plug-in"). If more line is necessary, additional telephone line can be spliced in, or a leased line used instead. The guard panel is connected to an earth ground and plugged into a power outlet in the guard room.
7. The system is ready for operation.

To adjust the sensitivity without connecting the guard panel, the tuning eye on the main chassis is used. When the main chassis is "set up" for nor-

Fig. 5. How the sensitivity of the completed protection system is adjusted. See text.



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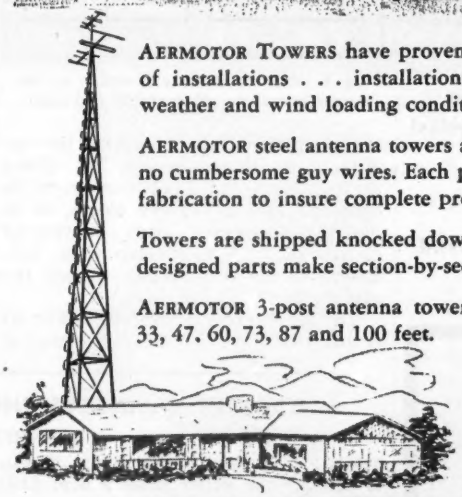

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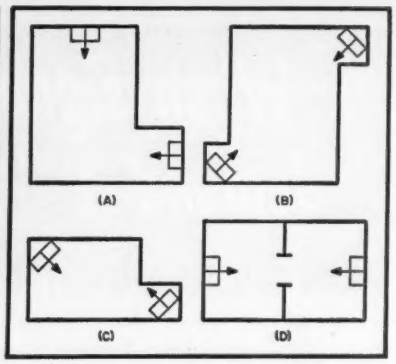


Fig. 6. Various methods of setting up the system to accommodate odd-shaped rooms.

mal operation (not in alarm), the eye is open, as shown in Fig. 5A. When there is sufficient body movement to cause an alarm, the eye closes, as in Fig. 5B. Greater body movement causes the eye to overlap (Fig. 5C). Excessive air turbulence causes the eye to "flutter" (Fig. 5D).

The sensitivity control (R_6 in Fig. 2) is adjusted until the desired degree of body movement anywhere within the protected room causes the eye to close. Normally, the adjustment is such that waving a hand will not cause an alarm, but an attempt to take a step or to "creep" immediately initiates an alarm.

Where the room is not a simple rectangle or square, but odd-shaped, reasonable care must be exercised in locating the transducers (in the carrying case "halves"). Examples of good locations are given in Fig. 6.

Note: Both transducers and other special components used in this unit are available from *Walter Kidde & Co., Inc.*, 717 Broadway, Newark, N. J.

Acknowledgements

Although the author was responsible for the design of the portable ultrasonic protection system in the form described, the basic ultrasonic alarm system was designed by Sam Bagno of New York, and he holds the patents on the system. The basic system was described by Stanley Kempner in an article in the April 1952 issue of *Electronics* under the title "Ultrasonic System Detects Intruders." —30—

ADAPTER CONNECTS PHONO PLUG TO MIKE INPUT

By ARTHUR TRAUFFER

USING parts out of his radio "scrap boxes," the writer made a neat little adapter that will connect a low-output phono pickup to a high-gain mike input on his amplifier. This simple adapter is completely shielded, and many uses will be found for it in experimental work.

For the body of the adapter, any tin can with a friction lid or screw-on lid can be used providing it is large enough in diameter to take the phono jack. The writer used a Doan's pill can, but a bouillon cube can could have been used instead. Aluminum cans are too difficult to solder to.

As shown in drawing below, saw off the front end of a standard female mike connector as indicated by the dotted lines. Next, using a fine-toothed narrow-blade hacksaw, saw off the can to give you a ½"-long bottom section. Lay the bottom section of the can on a hardwood block and chop out a ½" diameter hole in the bottom using a narrow chisel or sharpened blade of a small screwdriver. Scrape the inside of the can bottom clean and solder the mike connector into the bottom, as shown.

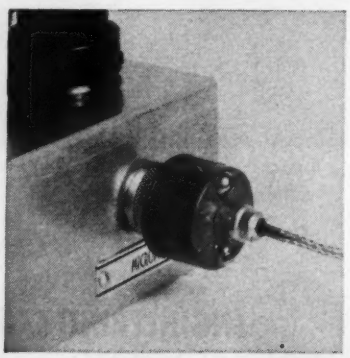
To mount the phono jack inside the lid of the can, drill the usual three holes and mount the jack in the same manner you would mount it on a chassis. Be sure that you scrape the inside of the can lid clean so the jack will make good contact with it.

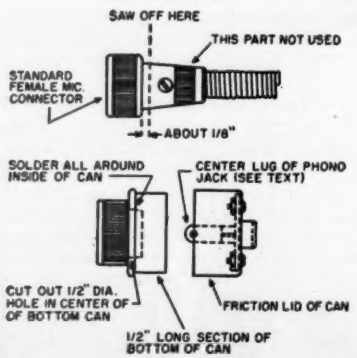
Now all we need to do is put the can lid onto the can bottom, and solder the center lug of the phono jack into the center contact hole in the mike connector. The writer simply cut the end of the phono jack lug to a point, so that when the can was put together the phono jack lug projected into the center hole of the mike connector so it could be soldered securely. However, if the center lug on your phono jack is too short to do this, you will have to use a short length of connecting wire as usual.

To insure that the two parts of the can make good electrical contact with each other, scrape off a little enamel near the bottom rim of the can where the two parts of the can join, and then apply a drop of solder.

The photo below shows the completed adapter in use. —30—

Mechanical details for constructing the compact adapter and photo of complete unit.




SAW OFF HERE
THIS PART NOT USED
STANDARD FEMALE MIC. CONNECTOR
ABOUT 1/8"
SOLDER ALL AROUND INSIDE OF CAN
CENTER LUG OF PHONO JACK (SEE TEXT)
CUT OUT 1/2" DIA. HOLE IN CENTER OF OF BOTTOM CAN
FRICTION LID OF CAN
1/2" LONG SECTION OF BOTTOM OF CAN

Electronic Latching Relay

By **RUFUS P. TURNER**

A sure and simple circuit for providing lock-in relay action.

FIG. 1 is the circuit of a simple lock-in type of relay. A transient 1½-volt pulse will close the relay, the latter remaining closed (subsequent pulses having no effect on it) until switch, *S*, is opened momentarily. *S* may be a normally-closed push-button switch.

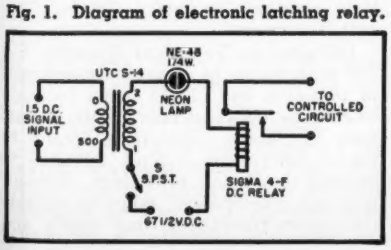
The circuit operates in the following manner. When switch *S* is closed, 67½ volts from a d.c. supply, connected to the two lower terminals, are impressed upon the neon lamp through the relay coil and the secondary of the transformer in series. However, this voltage is too low to fire the neon, no current flows in the circuit, and the relay remains open.

A 1½-volt, 50 ma. pulse applied to the signal input terminals induces a voltage across the secondary of the transformer. This voltage acts in series with the 67½ volts and momentarily raises the circuit voltage high enough to fire the neon. The resulting current closes the relay. After the pulse passes, the circuit voltage falls back to 67½ volts but the lamp does not extinguish because once it has been fired, it will continue to glow until the voltage falls to a critical value around 55 volts. The relay therefore continues to hold-in and will do so until switch *S* is opened momentarily to interrupt the current.

The neon is fired by the end, not the start, of the pulse. Polarities of the transformer and 67½-volt supply do not affect the operation.

While the author used a *Sigma* 4-F d.c. relay (8000 ohms, 1.6 ma.) any similar type with a 1- to 3-ma. rating can be used successfully. It has been found that the S-14 (with the terminals selected according to the numbers in Fig. 1) is not the only transformer that will work. Any model with a step-up turns ratio between 10:1 and 20:1 will do. Thus, a small carbon mike transformer is just right. —30—

Fig. 1. Diagram of electronic latching relay.



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LICENSING COURSES

Cleveland Institute of Radio Electronics, 4900 Euclid Avenue, Cleveland, Ohio has issued an interesting 16-page brochure describing its home study courses leading to FCC tickets.

Both the master course in radio communication and the advanced radio communication and engineering courses are described in complete detail with an outline of the curricula.

A free copy of this publication will be forwarded on written request.

PANEL METER DATA

Trio Laboratories, Inc., 4025 Merrick Road, Seaford, Long Island, N. Y. issued a short catalogue (No. VM-106) which describes its line of miniature, panel-mounting vacuum-tube voltmeers that are small enough to be built into operating or test equipment.

Both a.c. and d.c. models are described for commercial or military applications as is a new, low-level d.c. vacuum-tube voltmeter designed to meet military specifications.

RESINS FOR ELECTRONICS

Minnesota Mining and Manufacturing Co., 900 Fauquier Street, St. Paul 6, Minn. has compiled a 4-page illustrated booklet describing its "Scotchcast" brand synthetic resin products for electrical use.

In addition to listing available resins, the booklet cites examples of typical applications with data on flexibility, viscosity, pot life, cure times, and available forms.

A full-page chart lists such data in handy, easy-to-use form. For a copy of this publication, make all requests to Dept. D6-81 of the company.

RELAY BULLETIN

Complete details on its new low-cost, general purpose relay (Style #15300) have been included in a bulletin just released by *Price Electric Corporation,* Frederick, Maryland.

The relay has been designed for such applications as search tune auto radios, automatic headlamp dimmers, and photoelectric cell circuits. The unit is voltage operated and will operate on currents as low as 8 ma.

Write company direct for a copy of this bulletin.

TEST EQUIPMENT FLYER

Moss Electronic Distributing Co., Inc., 3849 Tenth Avenue, New York 34, N. Y. has an eight-page flyer available which lists and pictures an extensive line of test equipment manufactured by *Superior Instruments Company.*

Included is information on v.o.m.'s, an "Allmeter," tube testers, CRT checkers, a multi-purpose generator, and a service scope. Copies of the flyer are available without charge on request.

COPPER WIRE TABLES

The National Bureau of Standards has announced publication of a fourth edition of its "Copper Wire Tables."

These tables are of special importance to workers in the copper industry, electrical engineering, and related fields concerned with the distribution of electrical power.

All data in the book is expressed in both English and metric units. The American Wire Gage as presented in this publication is formed by geometrical progression. The circular also contains a number of simple formulas for computing data for any size wire.

Copies of this publication are obtainable from the Government Printing Office, Washington 25, D. C. Specify NBS Circular 31. Payments of 30 cents in coin for each copy must be included with the order.

RESISTOR REFERENCE CHART

A handy, file-size chart giving the essential electrical and mechanical characteristics of its line of variable composition resistors has been prepared by the Electronic Components Division of the *Stackpole Carbon Company,* St. Marys, Pa.

Called "A Quick Guide to *Stackpole* Variable Resistors," the new chart is printed in two colors on heavy stock suitable for wall, desk-top, or file drawer use. Illustrations and specifications for over 18 basic single- and dual-section controls are shown with a tabulation of all possible modifications available on each control, such as printed wiring or wire-wrap terminals, tab or bracket-mounting devices, line switches, phenolic shafts, etc.

Copies are available on letterhead request to the company.

GEIGER COUNTER BROCHURE

A brochure describing its Model 2612L Geiger counter for uranium prospecting is now being offered without charge by *Nuclear Instrument and Chemical Corporation,* 229 West Erie Street, Chicago 10, Illinois.

Full details on the features and operation of the instrument are included in the two-color, four-page bulletin.

PRINTED CIRCUIT TOLERANCES

As a service to the industry, the Engineering Department, *Photocircuits Corporation,* Glen Cove, New York has compiled and issued a technical bulletin entitled "Standard Printed Circuit Tolerances."

Included in Technical Bulletin P-9 are such items as diameter tolerances of unplated and plated holes, location tolerances between holes, hole to pattern tolerances, alignment (front to back) tolerances, circuit pattern to outside dimension tolerances, over-all dimension tolerances, holes to outside dimension tolerances, line width and

spacing tolerances, plating tolerances, etc.

The cooperation of electronics manufacturers throughout the country makes this bulletin comprehensive and authoritative.

MINIATURE TUBE GUIDE

The eighth edition of its "Reference Guide for Miniature Electron Tubes" is now available from *CBS-Hytron*, Danvers, Mass.

Revised and brought up-to-date, the new edition (Bulletin #PA-1) lists all miniature tubes, irrespective of make. It supplies pertinent data on 416 miniature types of which 88 are new, and 168 basing diagrams of which 33 are new. This 16-page brochure lists prototypes in larger bulbs.

Copies of the new guide can also be obtained from the firm's tube and semiconductor distributors upon request.

HYCOR'S COMPONENT LINE

Hycor, 12970 Bradley Avenue, Sylmar, California has issued a four-page bulletin which describes its complete and expanded line of precision electrical components for industrial control, guidance, telemetering, and audio equipment.

Bulletin G-3 includes basic specifications for encapsulated precision wirewound resistors, encapsulated toroid coils, miniature magnetic clutches, precision wave filters, telemetering filters, ratio transformers, miniature toroid power transformers, magnetic amplifiers, variable filters, and variable attenuators, among other items.

CONCORD CATALOGUE

Concord Radio, 45 Warren Street, New York 7, New York has recently issued a 32-page flyer which covers hundreds of items of interest to technicians, audiophiles, experimenters, hobbyists, and hams.

In addition to listing components and surplus bargains, tubes, books, and other items of interest to the electronic industry, the catalogue devotes considerable space to assembled units such as p.a. amplifiers, auto radios, tape recorders, tuners, etc.

For a free copy of this publication, write the distributor direct.

EICO EQUIPMENT FLYER

Electronic Instrument Co., Inc., 84 Withers St., Brooklyn 11, New York is currently distributing copies of a handy flyer that lists its complete line of available kits, instruments, and audio equipment.

Included with this pocket-sized folder is a free "pocket-saver" designed to protect the technician's shirt or jacket pocket when used to house small tools, pencils, pens, and rulers.

COLOR TV SERVICE BOOK

Publication of a new 92-page illustrated reference book on color television receiver servicing has been announced by the *RCA Service Company, Inc.* of Camden, New Jersey.

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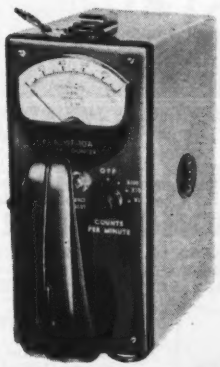

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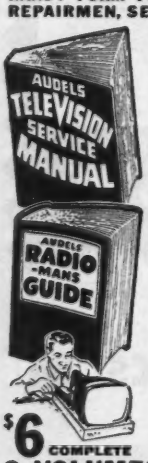

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Entitled "Servicing Color Television Receivers," the new book is designed for reference use by dealers and independent technicians who have attended the many color TV clinics and workshops conducted throughout the country.

The book, which deals specifically with the current *RCA Victor* 21CT-660U series, describes the tools required for efficient color receiver servicing, tells how to use these tools, discusses servicing procedures, etc.

Copies of this book are available from the Commercial Service Section of the company at Camden, N. J. for $1.00 a copy.

BUILT-IN RADIO SYSTEM

Phillips Radio Corporation, Highway M151, Temperance, Michigan is making available a four-page brochure describing its new built-in radio system for custom installation.

The bulletin is addressed to contractors and architects and describes a master radio system with speaker and four additional room speakers fitted with individual volume controls. The radio and room speaker panels are available in satin stripe chrome, copper, or gold finish.

Write the manufacturer direct for a copy of this brochure.

NUCLEAR INSTRUMENTATION

A four-page bulletin on nuclear instruments, counter tubes, and voltage regulator tubes is being offered to interested persons by *Anton Electronic Laboratories, Inc.,* 1226 Flushing Ave., Brooklyn 37, New York.

The two-color brochure illustrates and describes the company's ratemeters, survey meters, ore assayers, an instrument for sorting radioactive samples, as well as a line of stainless steel counter tubes, neutron detection tubes, and miniature and subminiature corona discharge voltage regulator tubes.

ALLIED FLYER

Allied Radio Corporation, 100 N. Western Avenue, Chicago 80, Illinois is now offering copies of its new equipment and parts flyer, No. 156.

This 64-page publication pictures and describes hundreds of new items ranging from tape recorders to TV accessories and service gear. A large section on audio equipment and components will be of special interest to the audiophile.

Copies of this new flyer are available without charge. Be sure to specify Catalogue No. 156.

SILICON POWER RECTIFIERS

Transitron Electronic Corporation, Melrose 76, Mass. has issued four new data sheets describing lead-mounted and miniature type silicon rectifiers; transistors, rectifiers, and diodes; and military-type silicon rectifiers (1N253, 1N254, 1N255, and 1N266).

Complete electrical specifications and mechanical data are given for each unit. —30—

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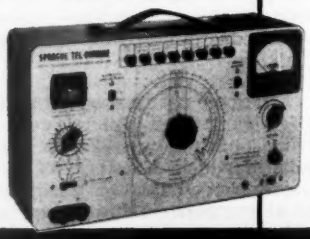

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Portable TV

(*Continued from page 37*)

Still another circuit innovation used in the *RCA* set is shown in Fig. 5. A single 6U8 tube is used in conjunction with three diodes in the limiter, sound i.f. amplifier, ratio detector, audio amplifier, and audio output circuits. The sound i.f. limiting is accomplished by CR_{101} with one side positively biased by a portion of the cathode bias from the second i.f. stage. Next, the pentode section of the 6U8 acts as a 4.5 mc. amplifier and drives the ratio detector transformer. Detection is performed by the two crystal diodes, and their output is fed back in the form of the audio signal through capacitor C_{110} to the pentode which now serves as an audio amplifier. R_{104}, the 33,000 ohm resistor in series with the ratio detector transformer, is the audio amplifier plate load. The signal then goes to the volume control and the output tube. The latter is the triode portion of the 6U8 and employs a specially designed output transformer. Approximately .5 watt can be expected from this audio system, with tone quality sufficient for a small portable set of this type.

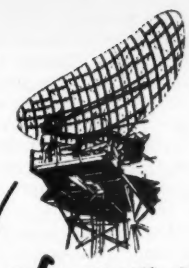
In the *G-E* type "M" receivers the maximum available "B+" is only 135 volts since neither a power transformer nor a voltage-doubler circuit is used. To get the required high voltage and deflection, the horizontal sweep output circuit uses some rather unusual features as shown in Fig. 8. The two horizontal deflection coils are connected in parallel and tapped down on the autotransformer. To eliminate the cathode bias circuit and obtain better linearity with maximum efficiency, the cathode of the output amplifier is connected to a special winding on the flyback transformer.

Servicing Problems

Many service technicians fear that the introduction of low-cost, small TV sets will bring the same service charge difficulties as experienced with servicing cheap a.c.-d.c. sets. It is almost certain that service problems with portable TV sets will be no simpler than with the more expensive conventional sets, yet the customer will expect to pay less for equivalent service work simply because the set was cheaper when new. In this respect the customer will have to be made aware of the facts.

As mentioned previously, many of the new portable sets use printed wiring which requires special methods for troubleshooting and repair. In general, printed wiring does not permit any faster or more efficient repair than the older system and estimates as to price and delivery on such sets should take this into account.

Another factor which makes portable TV receivers somewhat difficult to service is their compact construc-



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tion. For example, consider Fig. 9, which shows the two vertical chassis of the 8-inch *RCA* sets. These two vertical chassis or "decks" are bolted together and in order to perform any troubleshooting or repair the whole assembly must be taken apart first. To complicate matters, there are no easily accessible alignment or test points.

Alignment of these small receivers should be simple since few tuned circuits are used, but regeneration is possible because of the relatively high "*Q*" of the individual coils and the close proximity of the entire assembly. For this reason, the prescribed alignment frequencies must be observed accurately. To complicate matters, in many sets the alignment points are hard to get at unless the unit is disassembled.

One custom which has already become popular in the case of smaller table model radio receivers is the tendency of economy-minded customers to bring the set to the service shop for repairs. If this custom is extended to portable TV sets, service charges can be kept low.

Since most of these sets will be in primary reception areas, using an indoor antenna, local signal conditions in the immediate area may noticeably affect reception. In some instances, the service technician may have to take the set back to the customer's home to try it out and determine the trouble spot, especially if the set seems to perform well in the shop. In this connection it is well to look for aluminum blinds or awnings which, when raised, will not interfere with reception but when lowered can seriously reduce the available signal. Such instances have been observed by the author in otherwise excellent reception areas.

It may appear from the preceding that the new portable TV receivers portend additional trouble for the already harassed service operator. The introduction of these new models can also be considered in a more optimistic light. For one thing they will increase business since most of these sets will go to families already owning a TV receiver. Thus the service technician can expect to get more frequent calls from his regular customers. Another bright spot in the picture is that there may be a decrease in the urgent repair calls if there is more than one TV set in the home. This will lessen some of the pressure of the detested "hurry up" jobs. —30—

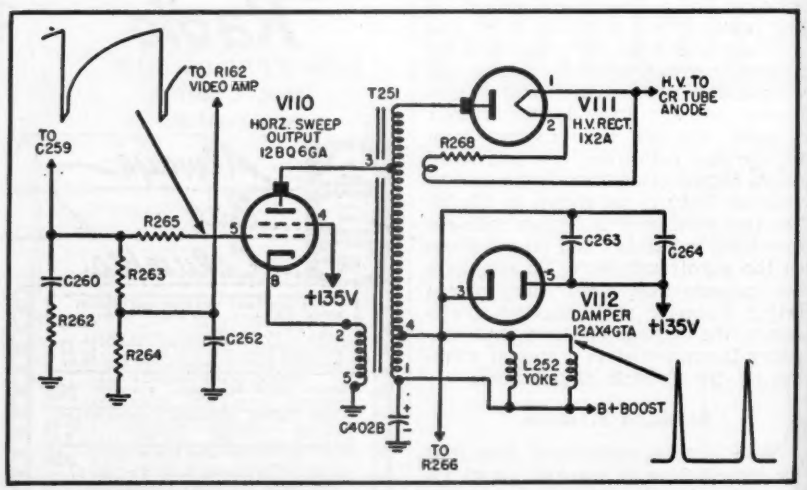
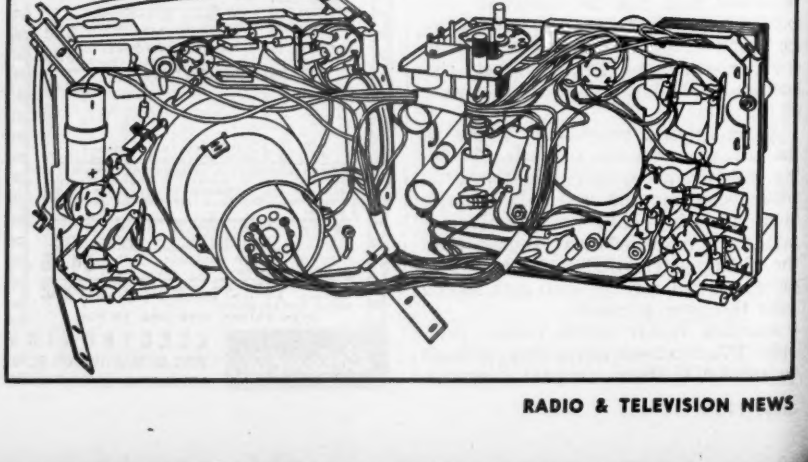


Fig. 8. High voltage section of the General-Electric model "M" receivers. The required 2nd anode and sweep voltages are obtained by using an autotransformer.

Fig. 9. The two vertical decks of the RCA portable TV chassis are shown here.



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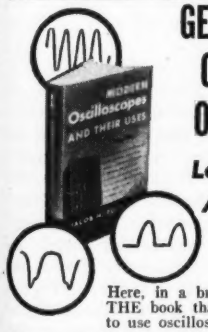

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Mac's Service Shop

(*Continued from page 71*)

the air and feed it into a dummy antenna. With the mike in front of a radio playing music, I listen to the signal on earphones plugged into my communications receiver working with no antenna. Sure enough I hear the distortion myself.

"Now I use the earphones in series with a blocking capacitor to signal-trace the musical signal through the speech channels. I find it undistorted at the plate of the first tube and the grid of the second, but the distortion is immediately apparent at the plate of the second tube. Checking voltages on this tube with the v.o.m. shows the grid is several volts positive instead of being at zero potential with respect to ground, as it should be. This points the finger of suspicion at the coupling capacitor. When it is unsoldered from the grid there is still a positive potential on the free end. It is leaky and is feeding through the positive voltage on the plate of the first tube. I replace the capacitor and listen to the signal again. The distortion is gone."

"A real snappy story," Mac commented; "but why didn't you include anything about safety measures which must be observed when working on ham transmitters?"

"Because that was handled by another talk at the same meeting," Barney promptly explained. "Any other questions?"

"None," Mac said with a grin. "Let's go to work." —30—

A study in contrasts. The tiny RCA Victor "Transistor Six," which weighs approximately a pound with batteries is the modern successor to the company's 1925 "Radiola 24," the 57-pound "portable" of its day. The "Radiola" model was the first of the luggage-type superheterodyne portables and, for its time, was a marvel of compactness and convenience. Thirty years later, however, thanks to miniaturization and the development of transistors, the portable user has a truly "pocket radio."

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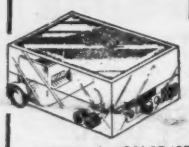
PRESTO RECORDING CORPORATION
PARAMUS, NEW JERSEY



EXCLUSIVE!!

3 TRANSISTOR RADIO KITS

by "KIT KING"

***DUAL POWERED, SUN POWERED OR CELL**

☐ **KIT #1 "SOLAR/CELL."** Dual-powered, pocket size unit; sensitive with ample volume. Sun Battery for daylite (works on 110W lamp, too), Mercury Cell for nite operation outlasts regular batteries five times! Pre-drilled plastic cabinet; step by step instructions; hi-gain transistor, diode, loopstick, variable condenser, socket, phone jacks, switch, wire, knob, hardware. Wt. 6 oz. ..... **$7.88 COMPLETE**

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☐ **KIT #3 "CELL."** Mercury cell powered. (Kit #1 less sun battery). Wt. 5 oz. . only **$5.55**

☐ **HI - IMPEDANCE PHONES** for above sets, only **$1.95**

☐ **SOLDERING IRON** with solder included, only **$1**

FREE! ANY $1 KIT WITH EACH $10 ORDER!

FAMOUS "KIT KING" $1 KITS

☐ **8-PC. NUTDRIVER KIT.** Plastic handle; 3/16, 7/32, 1/4, 5/16, 11/32, 3/8, 7/16" steel socket wrenches in plastic case. Wt. ½ lb. $3.50 value. **$1**

☐ **60 MICA CONDENSERS.** Postage stamp types, 25 values! .00001 to .01 mf to 1200 WVDC. Silver, 5%, too! Wt. ½ lb. Reg. $21. **$1**

☐ **60 CARBON RESISTORS.** Insulated, 25 values! 15 ohms to 10 megs; ¼, ½ & 2 w. 1 & 5%, too! Wt. ½ lb. Reg. $18. **$1**

☐ **40 MOLDED CONDENSERS.** Best known makes! Asstd. values. .0005 to 0.1 mf up to 1000V. Wt. ½ lb. Reg. $13. **$1**

☐ **25 TUBE SOCKETS.** Subminiatures, 7, 9-pin, 4 to 8-pins. Mica-filled and ceramic. Some shield base. Wt. 1 lb. Reg. $9. **$1**

☐ **50 CERAMIC CONDENSERS.** Discs, tubular, cartwheel, standoff types. 5 mmf to .01 mf up to 1000V. Wt. ½ lb Reg. $14. **$1**

☐ **30 DISC CONDENSERS.** Ceramic, 4.7 mmf to .01 mf, up to 1000V. Assorted values. Reg. $12. **$1**

☐ **50 RF COILS & CHOKES.** 20 types RF coils, chokes & slug-tuned coils for radio, TV lab. Wt. 1 lb. Reg. $15. **$1**

☐ **60 TUBULAR CONDENSERS.** 25 values: .00035 to 1 mf up to 6000V. Oils too! Wt. 2 lbs. Reg. $10. **$1**

☐ **DIODE KIT #1.** Four of the most used types: 1N21, 1N22, 1N23, 1N34A. Shop, lab must! Reg. $11. **$1**

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☐ **2000 PCS. HARDWARE.** Woodworking, radio-TV, shop screws, springs, grommets, etc. Hundreds of items. Wt. 2½ lbs. Reg. $15. **$1**

☐ **60 TERMINAL STRIPS.** Asstd. solder terminal strips & clips; 2 to 6 lugs. Reg. $4. Wt. ½ lb. **$1**

☐ **7 ROLLS HOOKUP WIRE.** Seven 25-ft. rolls #16 to 24. Asstd. stranding, insulation colors. Wt. ½ lb. Reg. $4. **$1**

☐ **12 AC-DC LINE CORDS** for all electrical equipments, 14" long w/ molded plugs. Stock up now! Wt. 1 lb. Reg. $3. **$1**

☐ **125 RESISTORS,** insulated and non-insulated, 35 values, 56 ohms to 1 meg; ½, 1 & 2W, A.B. & 5%, too. Wt. ½ lb. Reg. $15. **$1**

☐ **CRYSTAL RADIO KIT—** lowest price anywhere! Complete with 1N34 diode, loopstick, cabinet, condenser, wire, hardware, instructions. Reg. $2.50. **$1**

☐ **15 VARIABLE CONDENSERS,** Erie ceramic T-82A types, 10 values. Singles and duals. Wt. ½ lb. Reg. $12. **$1**

☐ **15 VOLUME CONTROLS.** Asstd. values to 1½ meg. W.W. too! Wt. 1 lb. Reg. $12. **$1**

☐ **150 PARTS!** Large asst. resistors, discs, tubulars, chokes, fuses, slugs, wire, etc. A rare buy! Wt. 2 lbs. Reg. $15. **$1**

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☐ **12 PANEL SWITCHES.** 8 types—micro, A, car, push, rotary. Reg. $12. Wt. 2 lbs. **$1**

☐ **7 PANEL LIGHTS** for miniature bayonet bulbs. Enclosed, adj., amber jewels. Panel mtg. Wt. ½ lb. Reg. $5. **$1**

☐ **10 "POLY" BOXES.** Asstd. sizes, hinged & snap lock clear plastic boxes, for pocket radios, parts. Hundreds of uses. Reg. $2.50. **$1**

☐ **SCOOP! 40 SUBMINIATURE RESISTORS.** Size: 7/64" x 1/16". 56 ohms to 4.7 meg. 12 values. Plastic cased, 1 & 5%, too. Reg. $8. **$1**

☐ **20 PRECISION RESISTORS.** Asstd. to 100 megs. Carbo-film, too! Well known makes, with production leads. Wt. ½ lb. Reg. $8. **$1**

☐ **20 Instrument KNOBS.** Knurled, skirted, precision instrument and equipment types; 10 styles, brass insert w/set screws. Reg. $9. **$1**

☐ **18 CERAMIC TRIMMERS.** Erie TS2A type. 10 values; singles & duals. Reg. $12. Wt. ½ lb. **$1**

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HOW TO ORDER Check items wanted. Return entire ad with check or MO. Include sufficient postage, excess returned. C.O.D. orders, 25% down. Rated, net 30 days.

Name ..... (please print)

Street .....

City .....Zone.....State.....

Enclosed $.....for items; $.....for postage.

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28 GARDNER ST. CHELSEA 50, MASS.

Visit our salesroom at 131 Everett Ave., Chelsea

RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

"IF YOU have a thing to sell
Don't go wishin' down a well;
Take your ego by the collar
Jump upon a roof and holler."

Whoever wrote that rhythmic bit of sage advice must have been looking at men who run radio and television service businesses when the inspiration struck him.

Not long ago your editor dropped in to see a man who owns a very successful service business. It is a well balanced business that handles auto radio service as well as that on television and radio sets. An attractive retail department was sectionalized for displaying a wide range of TV and major appliances with a well stocked traffic appliance corner. Actually, it is a well-rounded service center for the community it serves because it provides service on traffic appliances and almost any other type of device that plugs into a power-line socket.

Asked how business was, the owner said, "Not so good lately. Volume has been down." Then after a fast review of the situation, he proceeded to explain what was wrong with him and practically every other man he knew in the service business.

"We are chumps the way we fail to promote our businesses," he said. "We do not look ahead and plan for these seasonal let-downs in TV service. When they come, they come fast. Income takes a nosedive and we start scurrying around for a promotion that will quickly build volume on something else.

"It takes from one month to two months," he continued, "to plan a promotion, and to get the stuff printed and in front of the public long enough for it to bring in business. I should have started to promote something else two months ago to offset the drop in TV service that always comes along this time of the year."

He discussed his failure to consistently promote his auto radio service department. Prior to TV, he had had an excellent business on auto radios but under the pressure of keeping up with TV service, he had let his promotion programs on auto radio service die off. Now he is in the process of working up a long range campaign on this phase of his business to build it to the level where it should be.

"Then there is industrial and commercial sound equipment," he said, "that no one promotes. One of the large stores in town asked me to make a thorough check of its store-wide intercom and call equipment, make an entirely new installation, if necessary, and then take over its maintenance. The store wanted to drop its plan of internal maintenance because it was not satisfactory. I let it slide because we were swamped with TV service at the time. Yet it is a far more stable business than consumer TV service.

"There are hundreds of commercial and industrial establishments and small offices that would buy some kind of sound equipment," he continued, "if some of us would take the time to sell it to them and install it. Yet we all sit around griping because the service business is lousy."

Pump Priming

The fuel that powers any business, from the smallest service shop to the largest corporation, has a triple name —selling, advertising, and promotion. Good salesmanship in a service business is the way service customers are handled in every contact. A pleasant response over the telephone when a customer calls for service creates confidence. A friendly smile, simple explanations of what caused the trouble, and a wholesome interest in people will help you keep customers as regulars after they call you the first time.

The appearance of your service car and your shop, and your ads in the phone book and in daily or community newspapers all enter into the effectiveness of the way you advertise your business.

The third ingredient in this business fuel is labeled promotion. A service special to bring in business during a seasonal lull is termed a promotion. However, when you cook up a service special you must have some way of letting set owners know about it. If you had a fancy budget to spend, you could run some big newspaper ads about it. However, the profits from service are not adequate to support newspaper ad campaigns, so you must find a less expensive way to get word to prospective customers.

Small shops have found that direct mail and house-to-house distribution of literature is both the most economical and most effective way to get results. If you do not have mailing lists, the chances are good that a professional mailing concern in your town can provide you with a list of home owners in any area that you may want to cover. These companies will address and mail the material for you. The plan used by most service shops who have literature distributed house-to-house is to employ high school boys and girls for this work.

Radio service is the best source of summertime business for the average small shop. Many people break their regular TV viewing habits during the summer months and use their radios more. Consequently, they are more conscious of the defects that have developed in their radio sets.

An effective promotion, if it is intensively exploited, is to offer a "super-special" on 5-tube a.c./d.c. table model radios for a limited period of time. The "special" could be to offer to service any make of 5-tube table model radio for a limited period of time for $1.50 labor plus tubes and parts. One shop that exploited this special during August last year was swamped with radio service business for several months. This man planned his "August Special" early in July. He prepared copy for four handbills to be distributed, one per week, in the area he selected for this intensive promotion. Arrangements were made with a couple of high school age boys to take care of the distribution to about two thousand homes.

Distribution of the handbills started on the first day of August. Using a cross reference telephone directory, each day the shop owner's wife telephoned about twenty-five people in the area where handbills had been distributed the day before, to inquire whether they had received the handbills and if they had any radio sets to be repaired on this summertime special plan. By the middle of the second week of August, they had to add another technician to help handle the flood of radio sets that came in. This promotion not only provided a healthy profit during August but it also put this shop owner wise to a source of service business that has been badly neglected. This was the work available in repairing console radios.

Almost every home has a console with a radio-phono combination. Although the television set is the focal point for family entertainment, there is an interest in keeping the radio console in good repair since there is little interest in buying a new one. This is a good type of business for a shop to handle because there is no rush to have the set serviced and back on the job. It is the kind of work in which the customer will cooperate so it can be handled during the periods when TV service is off.

Another shop owner who put on an

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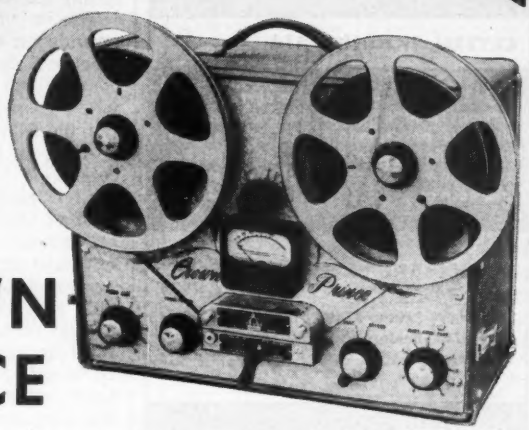

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Easily Portable. 10½" Reels. Rack mounting tape transport.

IDEAL FOR HI-FI INSTALLATIONS!

DUAL TRACK

IPS	Frequency Response Record and Playback	CPS	Flutter WOW	Noise Ratio
15	±2 DB 20-18000	CPS	.10%	55 DB
7½	±2 DB 20-15000	CPS	.15%	52 DB
3¾	±3 DB 40-8000	CPS	.25%	44 DB

Less Case $349.50

Write for literature. Address Dept. RN-7

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Set Builders—Experimenters

GIANT SURPRISE KIT $4.95

25-30 lbs. of brand new RADIO PARTS . . . no junk . . . Transformers, Filter and Bypass Condensers, Resistors; Wirewound, Carbon. Volume Controls, Sockets, Wire, Variables, Chassis and Gang Switches. Parts that every Service Man, Experimenter or Ham needs. Express or Freight Shipments Only. No C.O.D.

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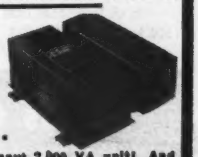
324 PLANE ST., Newark, N. J.

a TERRIFIC BARGAIN in a

SOLA CONSTANT-VOLTAGE TRANSFORMER

Ends fluctuating line voltage!



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the factory price at a 1-input 2,000 VA unit! And here's another bonus! This Air Forces 2,000 VA overstock, Sola Cat. No. 30768, has 4 inputs! 90-125 V., 190-250 V., 60 cy. or 50 cy. Isolated secondary is constant 115.0 V. ±1% from no-load to full-load of 17.4 amp. So, if you choose, use it as a 220:115 V. step-down. And slash $147.50 off the factory 1-input price!

Brand new in original wood box. 4 cu. ft. Ship. wt. 254 lbs. F.O.B. Pasco, Wash. Only..... $97.50

THE M. R. COMPANY

P. O. Box 1220-A Beverly Hills, Calif.

AMATEUR CRYSTAL Headquarters

CRYSTAL HOLDER DATA

FT-243 and FT-241-A holders have ½" pin spacing (2 of either of these crystals will plug into any standard octal tube socket). DC-34 holders have ¾" pin spacing-sockets available when ordered with crystals, each at **25¢**

NOVICEBAND

80 meters within 1 kc of specified frequency—3701 to 3749 kc in DC-34 or FT-243 holders—(specify holder wanted) **79¢**

40 METERS

From 7152 to 7198 kc within 1 kc of specified frequency in FT-243 holders only **79¢**

2—6—10—15—20—40—80 Meter Ham Bands in DC-34 or FT-243 holders (specify holder wanted) **79¢**

STOCK CRYSTALS

Send postcard for free list of frequencies. FT-241, DC-34, FT-243, FT-171, each **50¢**

SPECIAL CRYSTALS

Crystals ground and etched to exact frequency, using electronic counter, in FT-243 holders with ½" pin spacing. From 3000 kc to 9000 kc.

.05% tolerence $1.35 ea. .01% tolerence $1.50 ea.
.005% tolerence $2.50 ea.

Crystals ground and etched to exact frequencies in DC-34 holders with ¾" pin spacing. From 1691 kc to 4600 kc.

.05% tolerence $1.35 ea. .01% tolerence $1.50 ea.
.005% tolerence $2.50 ea.

STOCK CRYSTALS

In FT-243 holders—5675 kc to 8650 kc in 25 kc steps each, **50¢**

FT-241 LATTICE CRYSTALS

In all frequencies from 370 kc to 540 kc—50¢
500 kc Crystals—$1.00 455 kc Crystals—$1.00

Texas Crystals

The Biggest Buy in the U.S.

8538 W. GRAND AVENUE · RIVER GROVE, ILL.
ALL PHONES—GLADSTONE 3-3555

Terms: All items subject to prior sale and change of price without notice. All crystal orders MUST be accompanied by check, cash or M.O. WITH PAYMENT IN FULL. NO C.O.D.s. Postpaid shipments made in U.S. and possessions only. Add 5¢ per crystal for postage and handling charge.

August a.c./d.c. table model radio service special used a pick-up and delivery offer to get action. When telephoning after the handbills had been distributed, the offer was made that if they could pick up the set or sets that afternoon, pick-up and delivery would be made without charge. Through careful planning, the telephone canvass was focused on a concentrated area each day so a load of radios could be picked up with minimum travel.

The impending political conventions provide an opportunity to build summertime service volume. When the conventions get underway everyone who owns a TV set will want to watch the big show. There will be a sharp upsurge in the volume of TV service calls.

Alert shop owners will take advantage of the up-coming conventions to sell service during July and August in anticipation of the big events. A good "gimmick" for selling service during July and August is to offer customers a plan of extended payments without interest to pay for jobs that amount to twenty-five dollars or more. Obviously, arrangements should be made for adequate credit checks on customers who want to take advantage of the plan.

Promotions that Build

All types of businesses find it necessary to dream up special promotions to prime the business pump during seasonal lulls. But these are "fill-ins" that in no way minimize the necessity for steady, consistent promotion of the business the year around.

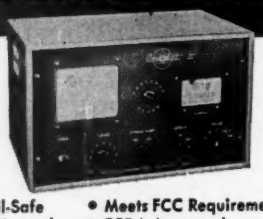
Figures recently released by the U.S. Bureau of Census show that 17% of the population move to new or different homes every year. That means that 17 out of every 100 of your regular customers will move out of your area this year and they will be replaced by 17 new families who never heard of you before. You must keep pounding away to make your business known to the new families that come into your operating area.

Surveys show that the average one-man shop takes in less than eight hundred dollars per month for service and sales. Obviously, when all of the operating expenses are paid, and the technician takes his own salary out of the business, there is not a great deal of money left to pay for promotions.

All of the receiving tube manufacturers provide professionally prepared promotional material that is so low in cost that even the smallest service business can afford all of the things needed for a well-rounded, consistent promotional program. A standard package of material for a small shop should include the following:

1. Imprinted letterheads, billheads, envelopes, and business cards
2. Imprinted stickers to be placed on the back of each set repaired
3. Imprinted "Good," "Fair," and "Bad" tube stickers to be attached to each tube tested

CONALERT MONITORS CONELRAD



- Fail-Safe
- 5 Channels
- Low Cost
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Effective as of Jan. 2nd, 1957—

MANDATORY FOR OPERATORS OF ALL RADIO TRANSMITTERS!

Kaar ENGINEERING CORP.

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To keep your HICKOK Tube Tester up to date, HICKOK reprints new roll-charts every 6 months. Easy to install. Send $1. Be sure to specify model number of your HICKOK Tube Tester.

THE HICKOK ELECTRICAL INSTRUMENT COMPANY
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in all Technical Phases
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A Service of Radio Corporation of America
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PM SPEAKERS (ALNICO #5)

Brand New Factory Guaranteed Stock
1 oz. mag. on 3" to 6", heavier mag. on 8" to 12"

3"	$ .98	6"	$1.58
4"	1.17	8"	2.64
5"	1.29	12"	4.67

SELENIUM RECTIFIERS

75 ma..$.49 | 150 ma..$.74 | 300 ma $1.19
100 ma.. .62 | 250 ma..1.08 | 500 ma 1.42

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Name .....
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4. Imprinted service order forms
5. Postcard mailers
6. Rubber stamp with shop name, address, and telephone number
7. A series of service selling ad mats

Decals for the service car and shop, an illuminated shop sign, window cards and display streamers, etc., should all be tied into the same theme and color scheme.

A substantial supply of all of these elements that are important in a coordinated promotion program can be obtained from any of the tube manufacturers through local parts distributors. By using the tube company's promotional materials, a small shop can get all of the material needed to keep in touch with a thousand home owners monthly for less than five-hundred dollars per year. The exact cost per shop would be determined by the number of set owners required as customers to provide the gross volume of business necessary to maintain the business and provide a steady growth.

A wide variety of promotion plans have been developed by service technicians to suit the individual requirements of their businesses and fitted to the communities in which they are located. Direct mail has proven to be the best method for promoting a small business when it is carried out consistently.

Many men buy the imprinted, government stamped postcard mailers from tube companies and, without fail, address and mail twenty-five to fifty of these cards to home owners every day. This staggers the job of addressing so that it is handled in a short time each day.

A list of 600 home owners would represent a potential service volume of slightly more than $12,000 per year on TV and radio sets. The total cost per month for cards and postage to keep in touch with 600 prospective customers would be about $36. By addressing about 25 per day regularly, no extra expense is incurred. Yet, each month without fail, each of these 600 set owners will get a little message from you reminding him of the services you can perform and telling him how to get in touch with you.

A decided advantage in direct mail for the small operator is that it can be concentrated in preferential areas and the calls that come from these sections will require a minimum of travel time to complete.

There is not a wired home anywhere that does not have either a radio or TV set or some kind of an appliance that needs service. The business is there—all around you. But you have to promote yourself to get those service jobs.

Association News

The Detroit City Council recently passed an ordinance requiring a license to conduct a business for installing and servicing television equipment. To qualify for a license, a

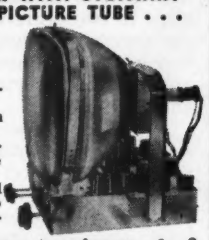
GRAND OPENING SALE

AIREX THE ELECTRONICS SUPERMARKET

TO introduce you to our large new home 4 floors of QUALITY MERCHANDISE at ROCK BOTTOM PRICES . . .

SPECIAL OPENING BARGAIN

COMPLETE TV SET—DESIGNED, ENGINEERED & MANUFACTURED BY TECH-MASTER WITH SYLVANIA ALUMINIZED PICTURE TUBE . . .



DESIGNED FOR FRINGE AREA OPERATION.

- 6 microvolt sensitivity
- Automatic gain control
- Auto-transformer high voltage system
- Synchronized sound and video
- 3 stage stagger-tuned IF

• Heavy duty power transformer • 2 stage video amplifier sweep circuit • High gain Standard Coil tuner • 17 KV high voltage output • Automatic brightness control • Complete with mounting brackets, Alnico V speaker and knobs. Chassis with Sylvania Aluminized Tube.

21"-$136.95 • 24"-$147.95 • 27"-$177.95

PICTURE TUBE GUARANTEED 1 YEAR

MASKS 1 piece Lucite for above tubes; Gold Border; outside mount

21"-$7.95-24"-$14.95-27"-$17.95

RECORD CHANGER BARGAINS

COLLARO RC 456: New 4 speed manual, automatic, intermix changer; weighted turntable, rubber mat, plug-in head, 4 pole motor. **$29.95**

WEBSTER MDL 140: 3 speed intermix, automatic shut off, dual styli cart. 2 pole motor. Reg. $37.50. **$21.95**

WEBSTER MDL 140 GE: 3 speed intermix, with GE reluctance RPX 050-A cart., dual sapphire styli, automatic shut off. Reg. $40. **$25.95**

MONARCH MDL UA6: British made, 3 speed, weighted turntable, intermix, automatic stop and shut off, heavy duty 4 pole motor, rubber turntable mat. Reg. $49.95. **$22.95** Less Cart.

GARRARD RC 121: New, 3 speed, auto-manual changer; heavy duty turntable, 4 pole motor, plug-in head. **$42.50** Less Cart.

GARRARD RC 88: Latest model, 3 speed, deluxe; weighted turntable, mat, automatic shut off, plug in heads. **$54.50** Less Cart.

GARRARD RC 98: 3 speed (variable) super auto-manual changer with 45 RPM adapter spindle. **$67.50** Less Cart.

RECORD CHANGER BASES & BOARDS

for the changers listed

BASES . . $3.89 MOUNTING BOARDS . . $1.95

12" Ball Bearing Phono Slides.....pr. $1.95

GENERAL ELECT GOLDEN TREASURE RELUCTANCE CARTRIDGE RPX 052A. Triple play .003 mill sapphire & .001 mill diamond. Clip-in Stylus. Stylus pressure 6-8 grams.... **$22.90**

RECOTON - GOLDRING MAGNETIC TURNOVER CART. "500." Triple play, .003 mill sapphire & .001 diamond. Response 20-16000 cycles. Stylus pressure 6-7 grams. Mounts in any tone arm with ½" hole centers **$22.93**

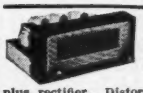
RONETTE HI-FI CARTRIDGE: with dual sapphire styli. For use with any of changers listed..... **$3.95**

45 RPM SPINDLES

GARRARD $3.49
WEBSTER $2.95
MONARCH $2.95
COLLARO $2.95

MULLARD HI-FIDELITY TUBES

Type	Replaces	Description	Price
EL34	KT66; 6CA7	For amplifiers up to 100 watts	$4.35
EL37	6L6; 5881; KT66	Increases power output 10-25% while reducing distortion level	$3.50
EL84	6BQ5	2 in push-pull delivers up to 20 w.....	$2.40
ECC81	12AT7	Eliminates microphonics & reduces noise levels.	$2.60
ECC82	12AU7	Eliminates microphonics & reduces noise levels.	$2.20
ECC83	12AX7	Eliminates microphonics & reduces noise levels.	$2.50
EF86	Z729; 6267	Reduces hum, noises & microphonics	$2.75
GZ32	5V4; 5U4	Delivers currents up to 300 MA. Sep cathode construction	$2.95



FM-AM TUNER KIT

Easy to assemble. Professional quality performance. 3 double tuned IF stages, Foster-Seeley discriminator, automatic frequency control & defeat. 7 tubes plus rectifier. Distortion less than 1%. Hum level —70DB. Sensitivity 6 microvolts for 20 DB quieting on FM & 20 microvolts on AM. FM selectivity 200KC band width 8 DB down; AM 8KC band width 5 DB down. 5¼" high x 9½" wide x 8" deep. **$29.95**

Complete with step-by-step instructions...

FM TUNER ONLY—$23.95 • COVER—$3.95

These units are ideal in combination with the Grommes Hi-Fi Amplifier.

Grommes Hi-Fi Amplifier Kit

10 Watts, 18 watts peak. Resp. 20-20,000 cps ± 1 db. Preamp., 4 inputs. Hum—80 db. 2% Harm. Dist at 10 watts. Complete with detailed step by step instruction manual, all resistors, condensers, tubes, wire & solder. Easy to make, 2—12AX7, 2—6V6, & 5Y3. Bass & Treble boost. Limited quantity. **$24.95**

5 WATT, 3 TUBE AUDIO AMPLIFIER

TONE & VOLUME CONTROL. With 12AU6; 35Z5; 50L6 & output transformer & extra AC receptacle. Phono jack input. 7½"x3" with mtg. brackets **$6.95**

Standard Coil Cascode TV Tuner

Replacement for any type TV set. 41 MC. IF. Shaft length 3¼..... **$9.95**

Knobs to match—89¢.

WESTERN ELECTRIC POWER AMPLIFIER

Complete with Ruggedized tubes 6SJ7, 6SC7, 6L6—condensers, chokes, resistors. Many uses. Original cartons. From radar equip. Gov't cost $95. Tubes worth $7.75 **$3.49** Complete

Send for our complete Hi-Fi Audio Catalog. When in N. Y. visit our camera department and complete Hi-Fi showroom with a full line of amplifiers, speakers, tuners and enclosures. Send card to be put on mailing list.

All merchandise is brand new, factory fresh & guaranteed. Mail & phone orders filled on receipt of certified Check or MO of 20% of items as a deposit. Balance C.O.D., F.O.B. factory N. Y. Prices & specifications subject to change without notice.

AIREX RADIO CORP. 64 Cortlandt St., N.Y. 7, N.Y. Phone CO 7-2137

THE NEW No-Noise TUNER TONIC with PERMA-FILM

Volume Control and Contact Restorer with Perma-Film

Cleans, lubricates, protects . . . not a carbon-tet solution. Still available in the new 6 oz. spray can. Net to servicemen—$2.25

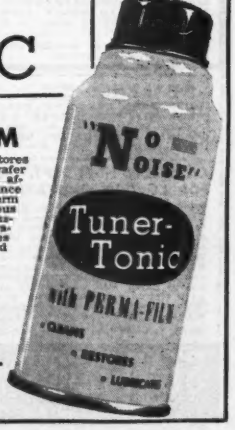
"NO NOISE"

2 oz. bottle. Net to servicemen **1.00**

Also available in 8 oz. bottles and quart cans.

At your nearest distributor.

Cleans, lubricates, restores all tuners including wafer type. Won't change or affect capacities, inductance or resistance. Won't harm insulations or precious metals, nor attack plastics. For television, radio and FM. Eliminates all noise, oxidation and dirt indefinitely. Non-toxic, non-inflammable, insures trouble-free performance. Extra economical because a small amount does the job! Net to serviceman. **$3.25**



ELECTRONIC CHEMICAL CORP.

813 Communipaw Avenue Jersey City 4, N. J.

STAN-BURN
S-P-A-R-K-S

CATHODE RAY TUBE SPECIALS
ONE YEAR GUARANTEE

G.E. Type	STAN-BURN	G.E. Type	STAN-BURN
$13.25....10BP4	$10.20	$28.15....17CP4	$19.50
18.00....10FP4	14.00	31.25....17GP4	28.75
16.25....12LP4A..	13.95	32.25....19AP4A....	22.50
12QP4....	10.50	27.40....20CP4	18.95
28.95....12UP4	14.50	33.00....21AP4	22.25
18.15....14CP4	13.40	33.25....21MP4	23.50
15DP4	14.50	27.40....21EP4	20.15
31.25....16AP4A..	18.50	90.75....24AP4	49.00
26.25....16KP4	15.75	**DUMONT TUBES**	
31.25....16GP4	18.50	12QP4A..23.75	16FP4..26.00
29.00....16LP4	15.25	15DP4..26.55	17KP4..25.00
29.00....16WP4	15.25	16DP4A..31.00	19AP4A 33.25
22.50....17BP4	15.75		21KP4..38.50

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

$20 WORTH OF ELECTRONIC PARTS IN GRAB-BAG consisting of: Porcelain sockets, coils, speaker, transformers, resistors, condensers, etc. ONLY $1.98 (plus 50¢ postage).

TAPE RECORDERS—Famous Brand

	SPECIAL		SPECIAL
List Pr. $249.95	$169.00	List Pr. $129.95	$79.95
List Pr. 199.95	129.00	List Pr. 79.95	59.95

Write for complete illustrated details.

WINDOW FANS

VORNADO—18" Blade—Reversible—list $89.95 SPECIAL $47.95 net

FRIGID—20" Blade—6 speed—Reversible with Thermostat control—list $89.95. SPECIAL $47.95 net
Westinghouse in stock—write for full details

AIR CONDITIONERS—Famous Brand

¾ TON 110V.....$199.95
G.E., Fedders, Mitchell, Westinghouse in stock
Write for full details and prices

Sensational VOCALINE TRANSCEIVER
(Featured in Radio News—June p.144)
NEW low-priced 2 way radio—transmits and receives upwards of 10 miles—OPERATES on AC or DC—PORTABLE—COMPACT (9"x6"x5") FCC approved (station license easily obtained).
WRITE FOR ILLUSTRATED DETAILS AND PRICES

TRANS-ATOMIC TRANSISTOR RADIO....KIT $6.95
Same as above WIRED, Ready to play.....$7.95
SENSIPHONE EARPHONES—Single Phone.....$1.50
Double Phone.....$2.50
GERMANIUM DIODE Loopstick Radio Kit.....$3.25

AM-FM-SW AUTO RADIO
Drift Free FM—World's Finest—Becker LeMans
For PUSH BUTTON.....$179.95
For SIGNAL SEEKER.....$239.95
Includes: GE SPEAKER with GRILLE and AUTOMATIC ELECTRIC ANTENNA. Simple installation for all cars. Specify 6 or 12 Volt system.

VM 3 SPEED HI-FI CHANGER—Model 950 with Ronette Sonotone or Astatic flip-over cartridge—BRAND NEW, ORIGINAL CARTONS.....$23.40

VM 4 SPEED HI-FI CHANGER—Model 1210 with Ronette, Sonotone or Astatic flip-over cartridge..$22.95

RC456-4 SPEED COLLARO—BRAND NEW. SPECIAL $29.95
45 RPM SPINDLE for above.....$2.98

3 SPEED PORTABLE RECORD PLAYER with MONARCH CHANGER—Ronette cartridge—Portable Two Tone Carrying Case.....$32.95

WEBSTER Model 140—3 SPEED Automatic with Ronette Sonotone or Astatic flip-over cartridge...$22.45

MONARCH 3 SPEED AUTO. INTERMIX CHANGER with crystal cartridge.....$21.95
Same with British variable reluctance.....24.95
45 RPM SPINDLE.....1.88
TU-3 MONARCH 3 Speed MOTOR & TURN-TABLE UNIT (less arm).....4.95

PEERLESS PORTABLE BATTERY OPERATED RADIO—Colors: Green, White, Red or Blue—5 TUBE IMPORT. $14.95 less batteries
BATTERY KIT for above.....$2.00

JEWEL—Model 5200—5 TUBE AC-DC RADIO..$12.50

RECORDING TAPE—Top quality—1200 Feet—Famous brand—BOXED—1 to 5—$1.69 ea. 6 to 11—$1.59 ea. 12 or more.....$1.49 ea.

HALLICRAFTERS TV
17" PORTABLE TV.....Dealer net $103.95
Model 17TS700M—Table Model...Dealer net 91.95
Model 21TS460M—Table Model...Dealer net 129.46
SETCHELL CARLSON—17" PORTABLE TV...$119.95

HI-FI PACKAGE DEAL
Includes: JENSEN K210 SPEAKER, MONARCH AUTOMATIC CHANGER with GE RPX 050, 12" SPEAKER ENCLOSURE in BLOND or MAHOGANY WOOD (Specify color), MATCHING BASE FOR CHANGER, 10 WATT HF10 BOGEN AMPLIFIER. Complete, ready to play. A $135.00 Value for Only..... $99.50 net
or your choice of similar units at relative package price. Write for prices.

DEALERS: Write for low cost prices and catalogs on '56 models—HALLICRAFTERS, CRESCENT, FANNON, SONORA, WILCOX-GAY, TECHNIMASTER, G.E., WESTINGHOUSE, TUNG-SOL, DeWALD, MAJESTIC, GRUNDIG, ARKAY KITS, DELCO, GEN. MOTORS. Address all inquiries to Dept. RN-7.

COMPLETE HI-FI DEPT. SEND US YOUR LIST FOR LOWEST QUOTATIONS ON ANY ITEM.

We invite export inquiries and offers. Our export department will give special attention to expediting foreign orders at minimum commissions. We are authorized distributors for United Motors, all Delco and Gen. Motors Auto Radio parts in stock. We also carry a complete line of popular makes of Radio Tubes at 50/10 discount. Also many other special purpose and transmitting types, and all electronic parts and equipment at lowest prices. Send us a list of your requirements for prompt quotations. Terms: 20% with order. Balance C.O.D. All prices F.O.B., NEW YORK Warehouse. Minimum order $5.00.

Write for our latest price list and Hi-Fi Catalog RN-7.

STAN-BURN RADIO and ELECTRONICS CO.
558 CONEY ISLAND AVE. • B'KLYN 18, N. Y.

service dealer must have a certified technician's license or regularly employ a full-time certified technician. Employees working under the direction of a certified technician are not required to have licenses.

The requirements for a certified technician's license are that the applicant must be over 21 years of age and have four or more years' experience in servicing receiving equipment or have technical training (trade, college, or correspondence school) equivalent to two years with a minimum of one year's experience. The cost for a service dealer's license is $25 annually and that of a certified technician $10 annually.

The San Francisco Bay area TV service associations and the International Brotherhood of Electrical Workers Local 202, concluded an agreement recently on a unique labor-management contract. The contract was described as a "bombshell that will slaughter the 'sundowner' and force the cut-rate shops to raise both their prices and their standards."

The major stipulations of the contract include a $4.50 minimum service charge; shops to be closed by 7 p.m., overtime or premium pay for Saturday and Sunday work; owners of one-man shops as well as the owners of the large shops to become union members. Under the reciprocal provisions of the contract, TV service shops affected by it would become union shops; the union, in turn, would take over the job of policing the industry by picketing non-union shops that charge less than the $4.50 minimum and picketing the homes of set owners who use the services of a cut-rate shop or a "sundowner." Additional pressure would be put on the "sundowner" by working for stiffer enforcement of city and county zoning regulations and for a radio and TV service state licensing law.

The five TV dealer and service associations in Philadelphia have teamed up in an aggressive drive to clean up the service situation in that area. They are winning the cooperation of their local distributors through their aggressive campaign to rid the area of the TV bargain tube racketeers. In a recent newsletter, Ed Lane of the Television Service Dealers Association said:

"Our distributors do not have time to hear each individual gripe. They do have time to sit down with representatives of an association and try to correct some of these evils. We don't know of any distributor who would refuse an association request for a discussion concerning a problem. Our distributors are, in general, upright men with honest intentions. I rather think they are just becoming aware of our collective voice. While we have been crying in the wilderness in the past, we are now being heard because more of you are backing us up in our fight for decent conditions within the industry." —30—

RADIO ELECTRONIC SURPLUS

APG 15 INDICATOR
Easily converted to a MODULATION INDICATOR Unit contains a 2AP1 tube with shield; also 9006 tube, miscellaneous potentiometers and resistors.
Brand new.....$5.00 each
Conversion data to miniature modulation indicator with schematic.....$1.50

DBM METER
0-200 microamp. Full scale. Hermetically sealed in 2" case. Manufactured by Marion. Brand new.
Each, postpaid.....$3.50

NAVY TRANSMITTER
T-19/ARC-5
3-4 mc.....$5.00 each
T-21/ARC-5
5-7 mc. .....$4.00 each
Slightly used; excellent condition.

NOTE: No C.O.D.'s. Enclose full amount of purchase with order. All merchandise F.O.B. Pasadena, California, unless otherwise specified.

C & H SALES CO.
2176 E. Colorado St., Pasadena 8, Calif.

"The House of Crystals"
U. S. CRYSTALS, Inc.
1342 S. La Brea Ave. Los Angeles 19, Cal.

LAM FLUX
ALUMINUM SOLDERING FLUX
The miracle you have been waiting for. Throw away your nuts, bolts and rivets. With this flux you solder Aluminum the same as other metals. *Send $2.00 Cash, Check or M.O.—No C.O.D. Postpaid in U.S.A.*
E. Lampe, P.O. Box 371, Lindenhurst, L. I., N. Y.

WANT A BETTER JOB? BECOME AN
ELECTRONIC ENGINEER
ONLY 32 MONTHS TO EARN A BACHELOR OF SCIENCE DEGREE IN ELECTRONIC ENGINEERING
Class enrollment limited to allow for individual instructions. Chartered by state of California. Nonprofit-nonsectarian, coeducational—established 26 years.
APPROVED FOR VETS—ENROLL NOW!
SEND FOR FREE CATALOG
PACIFIC STATES UNIVERSITY
1516 S. Western Ave., Dept. O, LOS ANGELES, CALIF.

Realistic High-Fidelity

(*Continued from page* 61)

in this way and, as I have shown, a straight-sided cone is not very good from the point of view of high note diffusion. Bakelite of this type is strong, resists wave-motion along the material, and gives extremely good treble response. I made many thousands of speakers in the nineteen-thirties with cones of this material, but finally abandoned it because of the manufacturing difficulties and the focusing of the highs.

Molded paper pulp is now used almost universally because it is cheap, light, comparatively strong, and can be given almost any shape. Moreover the outer surround can be incorporated with the cone and such intermediate corrugation as the designer may call for are easily provided. Inspection of such a cone must, however, be particularly directed towards any apparent varnish applied to the paper. Without varnish the material is hygroscopic and the cone will become limp in a humid atmosphere, spoiling the response at all frequencies; too much varnish, intended to make the cone stiffer, will only add to the weight, reduce transient response, and do nothing to improve the output at high frequencies. A simple test for varnishing is to wet a fingertip and press the surface of the cone; if the moisture seems to be absorbed like it would with blotting paper it can be assumed the speaker must be kept very dry to give its best performance.

Some cones will, however, show a glazed hard surface for a few inches near the apex; this is due to hot pressing between dies after painting with Bakelite varnish and is intended to help the treble response. Only the apex of the cone propagates the highs and obviously the cone "breaks up" in the process; the purpose of the Bakelising is to restrict the break-up to the zone beyond the apex, so that the extreme treble response is under control.

The flexibility of suspension can be checked by grasping the cone between the thumb and index finger of each hand across a diameter, the thumbs in front of the cone, the fingers inserted through the cone basket. The cone is then gently pulled forward and backward and an estimate made of the amount of permissible movement. When this has been determined, reference back to Fig. 13 will show what performance can be expected at the low frequencies. If, for example, a loudspeaker with a 12-inch cone has less than a quarter-inch free movement it cannot reproduce a 40-cycle note with 5 watts input because it will be overloaded. There will be no 40-cycle output, a little at 80, and most at 120 cps. This refers only to the freedom of suspension; other factors involving the magnetic system and dimensions of the voice-coil will be discussed later.

(*To be continued*)

PHAOSTRON 666 VOM

METER OVERLOAD PROTECTION AND OVERLOAD SIGNAL LIGHT. It is fused to prevent most common burn-outs and instrument damage. The 666 has complete meter movement overload protection. An overload signal light warns the operator of overloads, or incorrect polarity.

RAPID, RELIABLE AND ACCURATE MEASUREMENTS

43 Unduplicated Ranges.
Long (4 7/8") Scales are Color-Coded for clarity.
Illuminated Dial for easier reading.

AC CURRENT RANGES (from 1.5 MA to 15 Amps) **MEAN FEWER INSTRUMENTS TO CARRY**

RELIABLE PERFORMANCE

Doubly Shielded 45 UA movement assures continuous accuracy.
Permanent Accuracy 3% DC, 4% AC.
Sensitivity: 20,000 Ohms/Volt DC, 2,000 Ohms/Volt AC.

CONVENIENT TO CARRY

This instrument, with its unbreakable steel case, fits into the provided handsome leather carrying case which has space for all accessories.
Lightweight: 4 lbs. 4 oz.
Compact: 3 3/4" x 6 5/8" x 7 1/2".

Complete with Probes, Power Cord, Batteries and Leather Carrying Case at your Parts Distributor. **$59.50**

PHAOSTRON INSTRUMENT AND ELECTRONIC COMPANY
151 Pasadena Avenue, South Pasadena, California

COMMAND
ARC-5 TRANSMITTER

T-20...4 to 5.3 MC
T-21...5.3 to 7 MC
Brand New.... $49.95
3 to 4 mc. like new.....$5.95

Command Equipment (274N-ARC5, ATA)

Model	Less Tubes As Is	Excellent Used	Brand New
RECEIVERS			
520-1500 KC ...		$14.95	$19.95
1.5-3.0 MC		7.95	9.95
3.-6 MC	$2.95		
TRANSMITTERS			
2.1-3 MC		9.95	

T-23/ARC-5 UHF 2 METER TRANSMITTER—This terrific command transmitter has turret switching coils for all stages. Uses 1625 Osc., 1625 Tripler, 832A Tripler, 832A Final. Range 100-156 mc. 4 Channels are provided using 4 separate coils in an automatic turret using 12 or 24V motor or a manually operated system. These coils can very easily be re-wound for 6 and 10 meters. Complete with all Tubes. Excellent condition $9.95. Each
Brand New $18.95
R28—Companion receiver for above. Used Exc. $11.95

LORAN EQUIPMENT

Marine or Airborne LOng RAnge Navigational equipment! Determine the exact geographic position of your boat or airplane!
AN/APN4 Loran set. Frequency range 1700-2000 KC, complete with 1D6B/APN4 indicator, R9B/APN4 receiver, crystal and plugs.
Complete ..... Brand New $129.50
AN/APN-9 Brand New $295.00
(Quantity prices available—write)

$45.00 HI-FI Headset for only $7.95

Uses annular grooved plastic fibre comes with voice coils as in speakers, and brand new chamois ear pads to obtain spacing for correct acoustical load. GIVES FINEST MUSIC REPRODUCTION! Each capsule wired separately, with plug for binaural sound. Imp.: 300 Ohms per unit or 600 Ohms when wire in series. Brand new in original carton..... $7.95
USED EXC COND $4.95

RT-24/APX-2 IFF EQUIPMENT. 44 tube transceiver, 11—6AG5, 19—6C4, 7—6J6, 2—9006, 1—VR150, 1—5Y3, 1—2021, 2—2C26 with usable parts, tube sockets, relays, coax fittings, condensers, resistors, etc. 24 volt Blower motor, 24V gear train motor. Power transformer 400 to 2400 cycles.
Original govt. cost $750.00.
Brand New. Complete with tubes...ea. $14.95

A Sweet Oscilloscope Deal

INDICATOR. With 5CP1, mounted and shielded, with high-voltage divider network, focusing, intensity, horizontal & vertical positioning controls, and double-deck chassis with octal sockets for up to 27 tubes, plus 22 potentiometers, and resistors & capacitors. Light all aluminum, 9" x 12" x 19". New with 5-CP1. Less tubes and crystal. Only.. $9.95

Freq. Meter—Cavity tuned—absorption type—110 VAC 60 cycle 150 to 240 Mc.
Like New ..... ea. $24.50
100 to 127 Mc—Like New $24.50

PE-109 Inverter 12VDC input, 115V, 1.5 amps., single phase, 400 cycle output,
Brand New ..... $39.50 ea.
HS-33 600 Ohm—New ..... ea. $5.45

HS-23 Hi-Imp. headphones—Brand New... $5.45
TS-9 Handset—Complete with cord & Butterfly switch. Brand New Original Cartons..... $6.95
10 for $60.00
T-26 Mobile Chest Mike. Brand new.... $1.29

TWO METER VHF TRANSCEIVER

RT-19/ARC-4 Transceiver complete with all tubes in excellent like new condition. .Each $19.50

BC 906 Cavity type freq. meter. 144 Mc to 235 Mc. Complete with antenna and operating manual. Brand new—Orig. factory pack.....$14.95 ea.

SURPRISE PACKAGE
20 lbs. of MISCELLANEOUS ELECTRONIC EQUIPMENT—WORTH MUCH MORE than this low price of ONLY..... $1.95

DYNAMOTORS

Type	Input	Output	Used	New
BD-77	12 VDC	1000 VDC 350 MA.	$14.95	
BD-83	12 VDC	375-150 MA.....	1.95	$4.95
DM-64	12 VDC	275 VDC 150 MA.	3.95	5.95
DM-34	12 VDC	220 V 80 MA....	2.95	4.95
DM-35	12 VDC	625 VDC 225 MA.	Exc. Cond.	9.95

PHONES—Sound Powered, Reconditioned and Tested..... ea. $ 5.95
pr. 11.00

MOBILE HEAVY DUTY DYNAMOTOR: 14 V. INPUT-output: 1030 VDC 260 MA. Tapped 515 V. 215 MA. use or 6 V DC INPUT-500 V. 175 MA. While they last—DM-42-Excel. Condition. $4.95
Brand New $9.95

APG 5 or 15 CAVITY
10 Cm. 2C43 osc Xmitter, 2C40 Loc. Osc. Rec. 1B27 TR; tunes 2400 to 3000 MCS, less tubes.
Price $4.95

Receiver-Radio
Navy type 300KC to 23MC. Designed for optimum performance for the reception of pure modulated or interrupted CW.
Used Exc. $49.50
CRYSTAL—100 KC. $2.95
MG-149F—110V AC, 400 cycle-750 VA Inverter. Used..... each $9.95

WRITE FOR NEW BULLETIN AND PRICES.

ALL ITEMS F.O.B. CHICAGO
25% Deposit required with orders

R W ELECTRONICS
Dept. N, 2430 S. Michigan Ave., Chicago 16, Ill.
PHONE: CAlumet 5-1281-2-3

COLOR TV PROMOTION

An advertising and merchandising tie-in between *Cluett Peabody and Co., Inc.*, manufacturers of "Arrow Shirts" and the *RCA Television Division* has been developed for presentation this Fall.

Developed around the theme "The Look of Compatible Color," the program includes two full-color double-page ads in *"Life"* and the *"Saturday Evening Post"* plus additional promotion on the *RCA*-sponsored color TV show, "Producers' Showcase."

In addition to the advertising portion of the program, special window displays have been prepared for department stores. These will be augmented by promotional kits, including window streamers, point-of-sale displays, radio and television spot announcements, and other material.

* * *

SOLDER PACKAGE

Kester Solder Company, 4201 Wrightwood Avenue, Chicago 39, Illinois has come out with a new solder package

especially for the TV and radio service trade.

The new package is a pocket- or kit-sized edition of the firm's "Resin-Five" core solder which is non-corrosive and non-conductive. In addition to the new individual packages, the company has a counter display which holds ten of the new boxes.

Write the company for information on both the product and the display.

* * *

WESTINGHOUSE CAMPAIGN

Westinghouse Electric Corporation has launched an intensive campaign to obtain an annual consumer sales figure of one billion dollars.

The campaign will consist of a "product pre-sell" campaign using local papers and local radio; a dealer campaign; multi-color institutional ad insertions in major magazines; TV program spots; sponsorship of national political campaign coverage; dealer-aid program consisting of displays, consumer literature, demonstration devices, co-op advertising, etc.; and a schedule of ads in trade and technical publications.

* * *

DRIVE DISPLAY

Walsco Electronics Corporation, 3602 Crenshaw Boulevard, Los Angeles 16, California has developed a complete merchandising unit for its line of phono-recorder drives.

The compact display holds an entire line of vital replacement parts for

every major phonograph and tape recorder, old or new. In only 25% more space than originally used, the new display is said to stock twice as many belts and drives as any other display of this type.

Included in the display are all the new 1956 motor drives (domestic and foreign). A sample of the contents of each compartment is affixed to the outside of the display doors for speedy self-service and permanent inventory.

Write the company direct for complete information about the display and the line.

* * *

BATTERY MERCHANDISER

A combination floor, wall, or counter display, designed to solve the space problem confronting radio supply dealers, is now being offered by *Ray-O-Vac Company*, 212 E. Washington Ave., Madison, Wisconsin.

The sturdy radio battery merchandiser is specially constructed of wrought iron and selected woods for

modern, permanent construction. Designed as a three-way display, it makes a floor stand or with the re-

moval of the legs it can be used on the counter or hung on the wall.

For information on how dealers can obtain this display without charge, write the company direct.

* * *

RADIO CHEMICALS

General Cement Mfg. Co., 919 Taylor Avenue, Rockford, Illinois has introduced a convenient new display to facilitate the merchandising of radio chemicals.

Twenty-four different products and colors are featured on the new display. Such "Spra-Koat" items as "De-Ox-Id," "Spra-Kleen," wrinkle varnish, touch-up varnish, enamels, flat paints, and many others are included.

* * *

"SCENTS INTO DOLLARS"

CBS-Columbia is helping its dealers turn "scents into dollars" with a "sweet-smelling, sweet-selling" premium promotion.

Customers will be invited to pick up a free gift of "Sortilege" perfume at their *CBS* dealers' showrooms, thus giving the dealers an opportunity to present the 1956 line of TV receivers.

The company is supplying complete promotion kits to its dealers.

* * *

DELCO TUBE CARTON

The *United Motors Service Division* of *General Motors* has introduced a

new, more distinctive carton for its line of "Delco" electron tubes.

The colors of the new radio tube cartons and picture tube labels make product identification easier and more pleasing to the eye.

The white and orange lettering on the new packages used against a dark blue background is easier to read at greater distances. The new packages also provide adequate space for proper type number identification.

* * *

NEEDLE KITS

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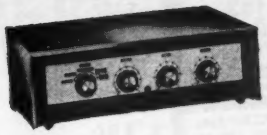

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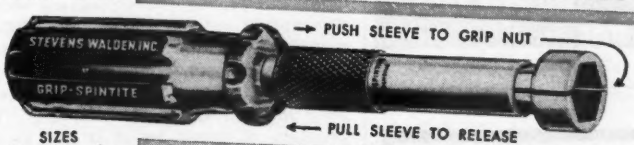

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Using Your Test Equipment

By MEL BYRON
Vice-President for Engineering
Precise Development Corporation

The tube tester can be very valuable—and it can be trusted—but it must be used within its limitations.

THE tube tester is certainly thought of with mixed feelings. Here is an instrument which is supposed to be able to indicate whether a vacuum tube is good or bad—and tubes are the leading cause of trouble in electronic equipment. It can literally save thousands of troubleshooting dollars, yet it is often not trusted, and more often not used. Some service technicians relegate it to the position of a "tube seller." Why this is true and ways of making the tube tester more effective in a service shop will be discussed here.

Let us consider what is required of a tube tester to properly test a tube:

1. It should, if possible, simulate the circuit in which the tube is normally used. Plate, screen, suppressor, control grid, and heater voltages and currents should be applied to the tube under test which are similar to those under actual operating conditions.

2. The tube should be tested for at least its most important characteristic. In the case of a power tube this would be plate current; for an i.f. or r.f. amplifier it would be G_m. Since power is a function of voltage and current, a power tube should be capable of delivering large currents. For such a tube, therefore, the plate current is of prime importance. In the case of an i.f. or r.f. amplifier tube, the voltage gain of a stage is the G_m (the mutual transconductance) times the load impedance. Here the stage gain is directly proportional to the G_m of the tube, making it the most important factor.

3. A gas test should be provided. One example of the effects of excessive gas in a tube is clipping. This is particularly annoying in the i.f. section of a TV set where the sync pulse may be clipped off, thereby causing poor horizontal synchronization. The problem of gassy tubes is not as noticeable in radio as it is in TV since, in radio, the general effect is an increase in distortion. In TV, sync is actually affected and the picture will tear or run.

4. A simple and effective short test should be provided. This is most often accomplished by means of a neon bulb with a resistor across it and another in series with it. The sensitivity of this circuit can be set by adjusting the two resistors. They are usually adjusted so that the bulb will light for leakage of 1 megohm or less.

The aforementioned lists the most important general conditions for tube testing. The question is, "why, if these conditions are met, can't we trust a tube tester?" The answer, of course, is that most tube testers do not meet all of these conditions. Certain short cuts have been taken in most instruments, primarily to keep the cost down, which limits the tests being made. If you understand the instrument which you currently have and realize its limitations, it will be able to serve you better.

There are many reasons why the service technician does not find his tube tester completely accurate. A few are listed here with suggestions for the proper use of tube testers.

Some tube testers check multi-element tubes as diodes. These testers have the advantage of being relatively inexpensive but their usefulness is limited. Most tube testers measure either G_m or emission. Determine which type you have and use its readings accordingly; G_m for i.f. amplifiers, and emission for power amplifiers.

Voltage and current conditions for the tube under test are not properly met in some checkers. This depends on the particular type of tester. A diode type does not meet the voltage conditions. This could account for a 6BG6 testing "good" on such a tube tester, but not working in a set. If the tester only draws 5 or 10 milliamperes of plate current, it certainly is not able to detect a weak power tube.

There are some tests that cannot be made intelligently by present-day tube testers without undue expense. These include checking high-voltage rectifiers and u.h.f. oscillators. A tube like a 1B3 should actually be tested with at least 9000 volts applied to its plate. It is impractical to test these tubes for anything more than emission in a conventional tube tester. Since a defective 1B3 tube shows up so effectively in a TV set, no attempt has been made to develop this high voltage in testing.

Faulty u.h.f. oscillator tubes will usually show up on a G_m test. However, when the problem has to do with transit time, the frequency of the voltage applied to the tube grid would have to be about 400 mc. to have any value. This is not practical in service-type tube checkers.

Many service technicians rely solely on tube substitutions for testing defective tubes. Tube substitutions are fine when it's a matter of replacing

one tube, but if the problem has to do with 4 or 5 weak tubes in an i.f. strip, replacing one probably won't make much difference. If all were replaced, and the set retouched in alignment, the change would be tremendous.

If desired, there are tube testers available which meet all the requirements for effective tube testing. Such a tester should be the greatest asset a service shop has. However, your present instrument, if used within its limitations, can be of great help and, when used correctly, can be trusted as well as a voltmeter. -30-

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SENSITIVE RELAY SWITCH

By GORDON MILLS

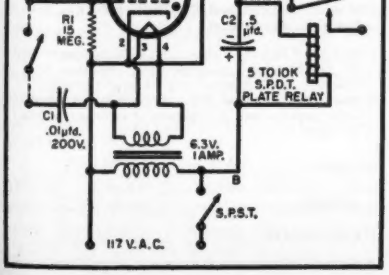
A SWITCH with a current rating of only one microampere will close the relay to be described here. It is useful in conjunction with a sensitive thermal switch as well as with many other types of low-current switches that are required to close a relatively high-current circuit.

When finding the value of R_2, the voltage between points "A" and "B" in Fig. 1 should be approximately 55 volts so that the current through the relay coil is normally between 1 and 10 ma., depending on the relay used. The value of R_2 will usually be between 10,000 and 20,000 ohms.

The value of C_1 may be anything over .01 μfd. However, as C_1 increases, more current is sent through the switch, reaching a maximum of about 8 microamperes with no capacitor at all. The value for C_2 given on the diagram will cause a slight delay in the opening of the relay. By decreasing the value of C_2, the delay will be shortened. Conversely, increasing the value of C_2 will increase the delay.

When the switch is closed, an a.c. potential from the filament is impressed upon the grid of the tube through C_1. This potential is of such a phase that it stops the tube from conducting and thus opens the relay. -30-

Fig. 1. Schematic of circuit designed to be used with sensitive thermal switches or other types of low-current switches.



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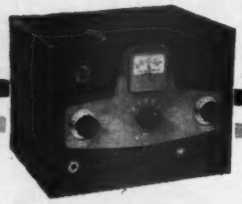

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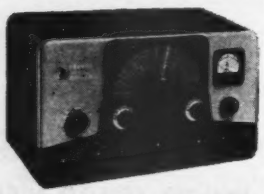

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"CLOSED-CIRCUIT AND INDUSTRIAL TELEVISION" by Edward M. Noll. Published by *The Macmillan Company*, New York. 227 pages. Price $4.95. Paper bound.

The fact that eventually industrial and closed-circuit television may exceed, dollarwise, its present application as a medium of entertainment is more than justification for those in the industry to keep abreast of these trends and prepare themselves for the change.

Many technicians are already enjoying the financial and prestige value of working in the industrial TV field and it is a foregone conclusion that more will follow suit. This book is for this group. Not only does it provide information on currently available systems but it suggests new and interesting possibilities for this medium.

One interesting feature of this text is complete construction details on a small television camera which the technician can build for experimental purposes and for experience.

This little book is packed with vital information and the reader will find it worthwhile both as a reference work and as a practical "how-to-do-it" handbook.

* * *

"THE QUEST FOR QUALITY" by N. H. Crowhurst. Published by *Norman Price (Publishers), Ltd.*, London. Available in the U. S. from *British Radio Electronics*, 1833 Jefferson Place N. W., Washington 6, D. C. 77 pages. Price $1.50. Paper bound.

In tackling a subject of such scope the author freely admits that his discussion must, of necessity, be non-inclusive but within this framework the author has made a good job of it.

The book is divided into ten chapters dealing with such subjects as a discussion of what constitutes the "ultimate" in audio reproduction, frequency response, harmonic and IM distortion, transient response and coloration, flutter and wow, dynamic range and background noise, equalization, stereophonic objectives, system building, and acoustics.

The treatment is non-technical and the copious use of illustrative material makes the text crystal clear to the hobbyist and layman.

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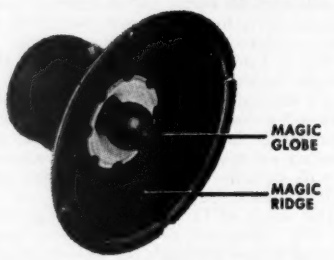

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Complete specifications on a representative selection of commercially available photocells and sun batteries are given for reference. Another feature which will be of interest to the experimenter is the listing of sources for the various components required to build the circuits described.

* * *

"ATTENUATORS, EQUALIZERS AND FILTERS" by Howard M. Tremaine and George K. Teffeau. Published by *Howard W. Sams & Co., Inc.*, Indianapolis. 176 pages. Price $2.75. Paper bound.

From the number of requests received for practical design information on these important audio system components it is obvious that there is a need for a book of this type.

The authors have rendered a real service to the audiophile since this text describes the design, application, and theory of operation of every conceivable type of attenuator, equalizer, and wave filter.

One especially valuable chapter is devoted to the hi-fi crossover network. Handy charts for determining component values required in designing equalizers and filters are an added boon.

So for all of you who have been looking for data of this type—here is your book crammed with practical information presented in its most usable form.

* * *

"BEAM ANTENNA HANDBOOK" by William I. Orr, W6SAI. Published by *Radio Publications, Inc.*, Wilton, Conn. 127 pages. Price $2.70. Paper bound.

It is hard to think up a single question about ham antenna construction, adjustment, and operation that is not answered in this fact-packed handbook. Whether you plan to build or buy a beam, your first purchase should be a copy of this book.

The text material is divided into 12 chapters covering transmitting medium, the array, transmission lines, matching devices, the parasitic beam, operational characteristics of the parasitic antenna, the design of parasitic arrays, the construction of all-metal and composite arrays, antenna evaluation, test equipment, and antenna installation.

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"HOW TO SELECT AND USE YOUR TAPE RECORDER" by David Mark. Published by *John F. Rider Publisher, Inc.*, New York. 138 pages. Price $2.95. Paper bound.

The "embarrassment of riches" that confronts the would-be buyer of a tape recorder has made the task so confusing to the average consumer that he is inclined to throw in his hand and buy a record player or borrow a tape recorder from his neighbor.

Recognizing the need for a "guidebook" to the realm of tape recording, the author has painstakingly compiled the answers to the questions most often asked by the average user. Since the author has correctly assumed that the market for such devices exceeds the technical background of most would-be users, the text has been prepared in non-technical language and at a level which anyone can understand.

A short preliminary chapter "introduces" the equipment and then the author discusses the operation of a tape recorder, how to make recordings, the applications of a tape recorder in the home, in business, and in the professions, and how to use a recorder for preserving especially enjoyable musical moments. The "directory" section on the selection of a tape recorder is a fairly comprehensive one and covers all types of units from small portable recorders to elaborate professional devices. Each commercial unit is illustrated and its special characteristics described—a boon to the average tape recorder fan.

* * *

"PROCEEDINGS WORLD SYMPOSIUM ON APPLIED SOLAR ENERGY." Published by the Association for Applied Solar Energy, 204 Heard Building, Phoenix, Arizona. 330 pages. Price $5.00.

This volume contains the full proceedings of the meeting on applied solar energy held last November in Phoenix, Arizona.

Papers by 30 internationally recognized authorities on solar energy utilization have been reprinted, along with photographs and drawings to illustrate the subject matter.

A summary of the round table discussion on "The Future of Applied Solar Energy" has also been included. Those interested in the subject will find this compilation helpful, enlightening, and an excellent springboard for additional study.

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"MOST-OFTEN-NEEDED 1956 RADIO DIAGRAMS" compiled by M. N. Beitman. Published by *Supreme Publications*, Highland Park, Illinois. 192 pages. Price $2.50. Paper bound.

This is the sixteenth of the radio receiver volumes in this popular series for service technicians.

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ERRATA

On page 96 of the March, 1956 issue, in "New Tube Tester Data," the settings for the Type 1629 tube listed for the Supreme Models 600 & 616 should read 90D2978 instead of 90D2778 as indicated. In other words, the fifth item should be a "9" not a "7".

* * *

The equation for the admittance of a parallel resonant circuit, given on page 62 of the February, 1956 issue ("Frequency Control Through Variable Resistance") should read as follows:

$$Y_t = j\omega C + \frac{1}{j\omega L} + \frac{j\omega C_1}{1 + jR\omega C}$$

The error in the equation given in the text does not affect the values in the remainder of the article.

* * *

The principle of operation of the auto radio search tuner discussed in the March, 1956 issue (pages 48 and 164) is as follows rather than as was described in the article. The i.f. signal voltage at the second i.f. transformer secondary is coupled to the grid of the first section of the 12AU7 trigger tube, operating as a detector-amplifier. This signal causes the detector-amplifier to conduct sufficiently to drive the second section of the 12AU7 into cut-off, thereby de-energizing the relay, and stopping the sweeping or search action of the tuner. Negative a.v.c. signal is also applied to the grid of the detector-amplifier, but its purpose is to act only as a delay in stopping on certain signals, so that the tuner does not stop on the sideband of strong stations. Because of the above, a negative trigger voltage on the grid of the detector-amplifier will not stop the tuner sweeping action.

Also, when the actuator switch is first depressed, both cathodes are placed nearer ground potential (less positive voltage). At this time the detector-amplifier does not conduct but the relay section of the 12AU7 conducts and holds the relay energized. This allows the tuner to search or sweep. The detector-amplifier conducts only when a signal is applied to its grid.

A precautionary statement should have been included where the recommendation was made to check the mechanical system for binds by pulling the relay stop or armature out of the paddle wheel and then applying power and seeing if the sweep operates and returns properly. Extreme care should be exercised in this test so as not to damage the relay contacts. The relay arm must be pulled very gently to prevent bending these contacts.

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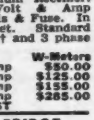

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2K25	11.95	805	3.95	5819	34.50
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2K33A	56.90	807	1.18	5851	3.45
3AP1	2.90	808	1.25	5876	12.50
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4C27	3.25	830B	.65	9001	.82
4C28	17.45	832	5.75	9002	.60
4C35	13.45	832A	7.95	9003	.90
4E27	7.95	833A	37.50	9004	.33
4X150A	22.45	836	1.45	9005	1.39
5BP1	2.35	837	.88	9006	.25
5BP4	1.95	838	.69	C1JA	10.95
5C22	27.50	845	4.85	C6J	6.45
5CP1	1.95	851	8.95	CK1005	.32
5CP7	7.95	860	2.75	CK1006	3.45
5D21	4.95	861	12.95	CK1007	.65
5FP7	1.37	866A	.98	F-123A	2.75
5JP1	12.45	869B	14.95	F-127A	22.50
5JP2	6.35	872A	1.25	F-128A	14.95
5LP1	7.40	876	.72	FG-17	2.90
5NP1	4.95	878	.48	FG-27	12.95
6AN5	2.75	884	.95	FG-32	3.95
6AS6	1.19	885	.95	FG-95	17.50
6AS7G	2.35	902A	2.95	FG-105	12.95
6C21	14.95	918	1.65	FG-172	17.95
6J4	2.55	923	1.25	HF-100	6.95
7BP7	4.95	927	.95	HF-200	9.95
12DP7	17.50	930	1.19	HF-300	17.50
15E	1.05	931A	2.45	WL-616	47.50
28D7	.75	954	.25	MX-408U	.50
100TH	6.25	955	.35	RK-65	7.50
211	.45	956	.35	RK-72	.50
212E	14.95	957	.35	RX-21	5.50
249C	1.95	958	.35	TZ-40	3.50

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